AIR CONDITIONING HEATING AND VENTILATING

FEBRUARY 1961

For the Engineer
Engaged in DESIGN
APPLICATION
ESTIMATING
SPECIFICATION
and LAYOUT

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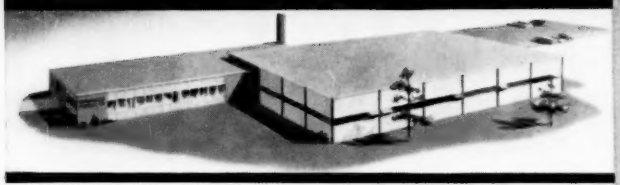
Large-scale snow making operations at The Homestead, Hot Springs, Va., are providing fast slopes for skiing fans and a full year of activities for the luxury resort. For story see page 87.

If your problem is EFFICIENT HEAT AND HOT WATER with No. 2 Oil for the medium-sized building . . .



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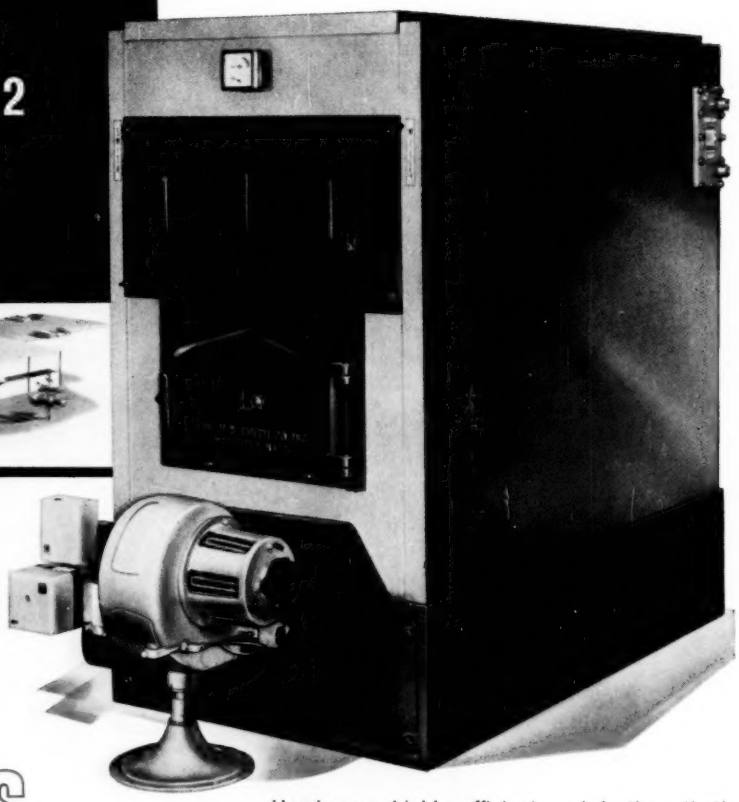

Handsome, highly efficient and lasting, that's the Smith-Mills 2500. Many features including vertical water tube construction, extended fin surfaces, heavy fibre glass insulation to prevent heat loss, unusually clean burning precision built burner of high combustion efficiency.

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The next time you are about to specify an oil-fired heating unit for a commercial building of moderate size, consider the Smith-Mills 2500. It is available for either hot water or steam and in six sizes. It uses No. 2 oil and has a burner capacity of 4.45 to 9.25 gallons. Electronic control is standard on the 8, 9 and 10 section boilers. It is available optionally on the 5, 6 and 7 section boilers.

The Smith-Mills 2500 is ideal for restaurant, garage, motel, store or small factory use. This integrated unit is designed to furnish trouble-free heat *and continuous hot water service* with a minimum of boiler room supervision and maintenance. Sections of rugged cast iron assure extra-long life. Extra-long flue travel assures greater efficiency and economy.

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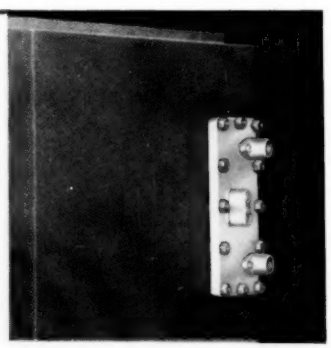

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Some Straight Talk On Steam Trap Capacity

...or pulling away the curtain of confusion that surrounds steam trap capacity ratings.

Unfortunately, for the steam trap buyer, the subject of steam trap capacity has become cloudy and confused by a landslide of claims, counterclaims and inconsistent "standards" for measurement. So let's take a cold hard look at this subject so vital to the efficient operation of your plant.

What Determines Steam Trap Capacity?

There are three factors that determine the capacity of a steam trap:

1. The area of the orifice.
2. The density of the condensate.
3. The pressure differential across the trap.

Let's take a closer look at each of these:

Area of orifice is usually specified by the trap manufacturer or can be calculated from the diameter. Nothing complicated here.

Density of condensate depends on temperature. A cubic foot of cold water weighs 62.4 lbs. At 250° F. or 15 psi, it weighs less than 59 lbs. This is important. Don't overlook it.

Pressure differential across the trap is most significant. And it is complicated by the many factors that affect it, such as:

1. Pressure drop between unit drained and the trap when the trap valve is open.

2. Distance the trap valve is moved from the valve seat.

3. Back pressure on the trap with orifice closed; i.e., return header pressure.

4. Increase in back pressure produced by condensate and flash steam flowing in the discharge line. This in turn is affected by the diameter and length of the discharge line, plus friction caused by valves and fittings.

Orifice Capacity Vs. Steam Trap Capacity

Figure 1 shows a ½" diameter sharp-edged orifice at the end of a pipe filled with cold water at 15 lbs. pressure. The capacity of this orifice, using a .61 coefficient of flow would be 8,800 lbs. per hr. Now, would this ½" orifice if used in a ¾" steam trap installed as shown in Figure 2 provide the trap with a continuous discharge capacity of 8,800 lbs. of hot condensate per hour? The answer is "no". And here are some of the reasons why:

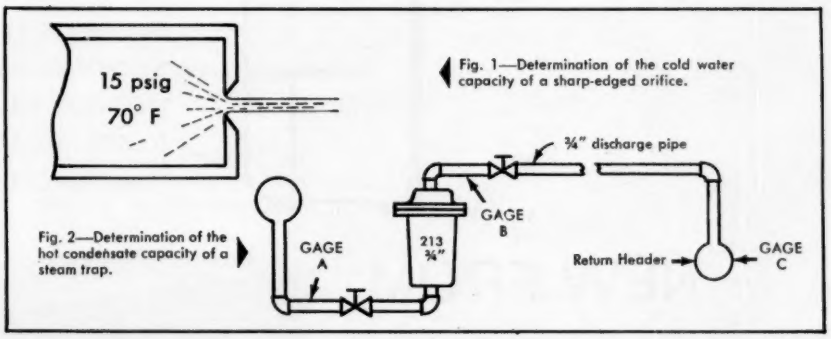


Fig. 1—Determination of the cold water capacity of a sharp-edged orifice.

Fig. 2—Determination of the hot condensate capacity of a steam trap.

Density of condensate. As pointed out above, cold water weighs 62.4 lbs. per cu. ft. At 15 lbs. pressure and 250° F. water weighs less than 59 lbs. per cu. ft. This difference in density alone reduces the lbs. per hour capacity of the orifice by over 5%.

Pressure differential across the trap. With the trap valve closed we have a static pressure differential of 15 psi. The trap valve must be able to open against this pressure. However, this is not the pressure differential that will determine the capacity of the trap valve.

The ¾" discharge line will be full of a mixture of flash steam and condensate. To keep this mixture flowing from the trap outlet to the return line requires a pressure differential. In actual capacity tests run as shown in Figure 2 Gage B at the trap outlet registered 11 lbs. back pressure. Thus the true pressure differential across the trap was about 4 lbs. Under these conditions the measured capacity of the trap was 4,340 lbs/hr. or just about half of the capacity of the ½" orifice for cold water.

How Armstrong Determines Capacity Ratings

Armstrong trap capacity ratings are based on hundreds of tests under actual operating conditions. In these tests, the condensate used was at the steam temperature corresponding to the test pressure. Thus, the capacities determined take into account the pressure drop that occurs when the trap orifice opens and the choking effect and back pressure of the flash steam. Actual installation hookups were used so that pipe friction in both inlet and discharge lines as well was reflected in the results.

Let's go back to the example cited above and in Figure 2. The trap referred to is an Armstrong No. 213. While it did test out at 4,340 lbs. per hour for a static pressure differential of 15 psi, it is rated in the catalog at only 3900 lbs. per hour for this pressure—just to be on the safe side.

For the trap buyer, this means that Armstrong Steam Trap capacities are based on handling condensate at steam temperature for the stated static steam pressure differential under actual working conditions.

Capacity ratings which don't take into account all of the variables will be misleading and may lead to the selection of undersized traps. So whenever you specify or buy traps be sure that the capacity ratings you work from are realistic. One way to be sure is to select Armstrong Traps with *guaranteed* capacity ratings.

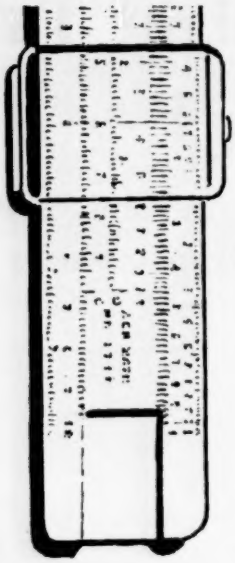
* * *

Additional information on trap capacity ratings, plus data on how to correctly size, install and maintain steam traps for any pressure, any temperature and any load, are presented in the 48-page Armstrong Steam Trap Book. Ask your local Armstrong Representative for a copy or write:

Armstrong Machine Works
8464 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

"See our catalog in Sweets Plant Engineering File"
For more data circle this page number on card at back of book



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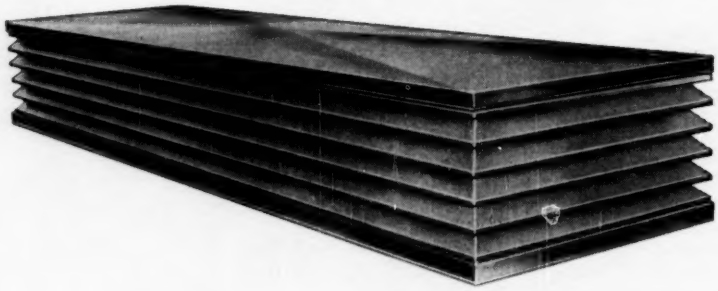

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Important for every engineer to have on hand is the new Pennhouse Technical Bulletin BSO-60 which now offers valuable engineering data, and for the first time, the most complete sizing chart that simplifies selecting the proper size unit for any given area. Get all the facts today on how the Pennhouse can serve your roof ventilation requirements. Write direct . . . or contact your local Penn representative.

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Volume 58, Number 2 **February, 1961**

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COVER PHOTO: In line with our avowed policy of frustrating nature at every turn (i. e., creating warmth in winter, making coolness in summer, and melting snow when it does fall), we proudly present, for your interest or profit, the story of how one resort hotel **engineered a system for man-made snow,** and turned a "slow" season into one of its busiest with the addition of winter sports. The article starts on page 87.

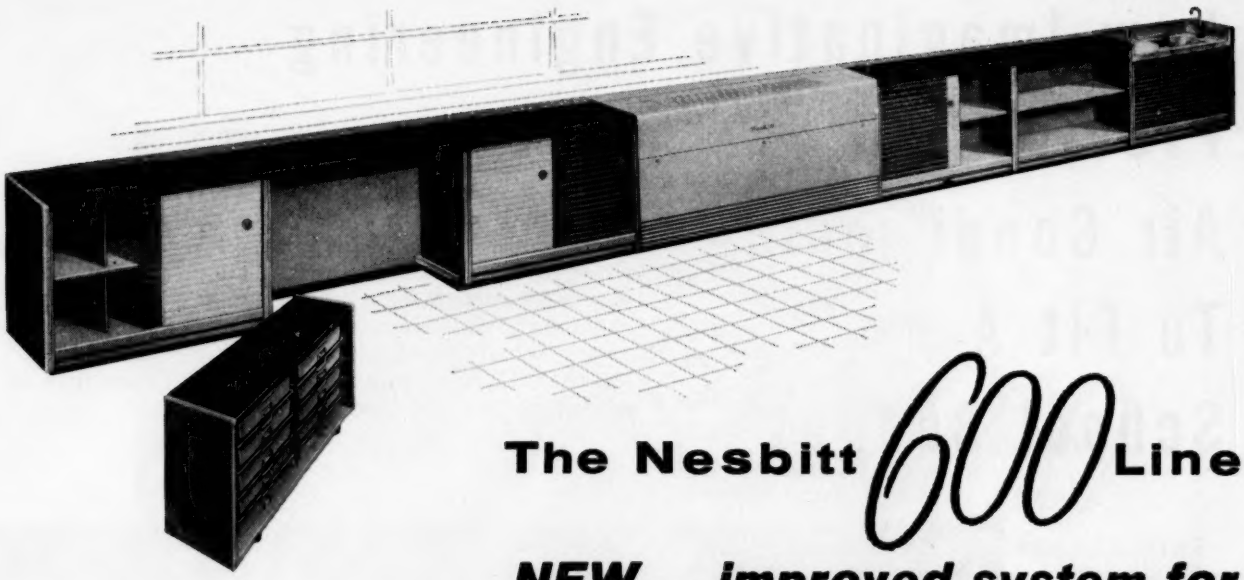
HIGH SPOTS in this issue

EXPOSITION AND CONVENTION: As a noted television personality would say, it's going to be a "really big show." We're referring, of course, to the upcoming semi-annual meeting of ASHRAE and the International Heating and Air Conditioning Exposition to be held in Chicago, Ill., from February 13 through 16. The convention program consists of four technical sessions, six forums and four symposiums. These meetings and the papers to be presented are described in a pre-convention report appearing on page 91. Also listed are the exhibitors who will be attending the Exposition.

CAPACITY CONTROL: Except in rare circumstances, any air conditioning or refrigeration system **will be required to operate at variable load conditions** due to changes in occupancy, solar effect, outside dry bulb and wet bulb temperatures, wind velocities and internal heat generating sources, according to J. R. Harnish in introducing his **Reference Section,** beginning page 101. It then becomes necessary for the mechanical cooling system to adjust its capacity to meet the instantaneous load requirement.

PERFORATED CEILINGS: Air conditioned areas having average sensible heat loads can well be served by "all-air" type systems in which the **treated air is introduced to the conditioned space through a perforated ceiling.** In his article beginning on page 98, Maurice Wilson describes some of the commercially available types of perforated ceiling materials, and includes application details for their use. An interesting supplement to his article is one in this month's **Applications and Installations** department, page 134, telling how Armstrong Cork Company perforated its own standard mineral tile and created a suspended ceiling installation which combined air distribution and acoustical treatment in its general office building.

KNOCKOUT DRUMS: Even in a well designed refrigeration system, the danger of **liquid carryover** to the compressor is not too remote. In this month's **Specification and Design Seminar,** page 130, Mel Ramsey shows how refrigerant slugs are produced and how to design the system to minimize slug formation. He recommends the knockout drum be installed as the ultimate protection against costly compressor damage. **The author welcomes inquiries for more information about the topics covered in the Seminar,** or for technical information on other topics in his field. If addressed to The Editor, they will be forwarded to the author.



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NEW... improved system for

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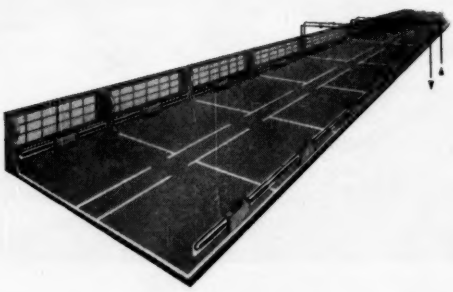

Wind-o-line Radiation makes the difference!

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Of course you like the beauty of modern lines and colors . . . and you welcome the fact that these new integrated storage cabinets provide the mobility and flexibility demanded by creative teachers . . . but of prime importance to *you*, as a designer for classroom thermal comfort, is the fact that the features and advantages of Wind-o-line Radiation have been retained in the new Nesbitt Series 600 Line.

Wind-o-line solves the cold downdraft problem . . . but more than that: In a forced hot water system the copper tubing of Wind-o-line finned radiation serves as the supply and return piping for the Syncretizer unit ventilators in a whole group of classrooms. Costly pipe trenches, conventional mains, run-outs and pipe coverings are eliminated.

Syncretizer multiple serpentine heating elements deliver the required heating capacity with water quantities a third or less of those demanded by conventional elements; and the additional heating surface provided by Wind-o-line further reduces the water quantity. Smaller pipes and pumps are used.

The gravity heating capacity of the Syncretizer with Wind-o-line radiation is more than sufficient to maintain adequate building temperatures during shutdown periods. Special controls and intermittent fan operation are unnecessary.

Thus, for daytime comfort, nighttime protection, and *reduced system costs*—WIND-O-LINE MAKES THE DIFFERENCE!

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How Imaginative Engineering Provided Air Conditioning To Fit A School Budget

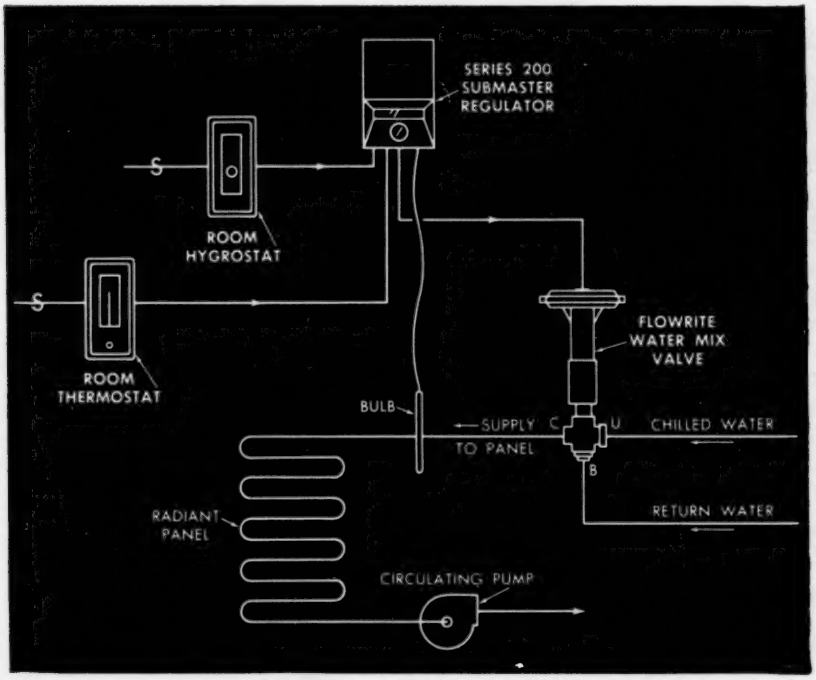
Must school air conditioning always be "too expensive"? Perkins & Will, Chicago architects and engineers, didn't think so last year when they designed suburban Homewood-Flossmoor High School. Without exceeding the school budget, they provided an air conditioned area large enough for complete summer sessions, including 15 classrooms, the library and all administrative offices. Actually, cooling for 25,000 square feet added less than 3½% to normal building cost — less than $4 per square foot of cooled area.

Homewood-Flossmoor High School, Flossmoor, Illinois. Air conditioned section (center) connects to other school facilities by glass-enclosed passageways.
Architects and Engineers: PERKINS & WILL, CHICAGO
Mechanical Contractor: THE ECONOMY PLUMBING AND HEATING CO. OF CHICAGO.

Perkins & Will team of architects and engineers works out details of the cooling system design features and controls for the Homewood-Flossmoor school. From left to right are F. Philip Brotherton, Designer and Project Architect; Rudolph J. Houkal, Chief Mechanical Engineer, and Edward C. Colin, Chief Structural Engineer.

How it was done

Perkins & Will grouped all rooms where both heating and cooling were desired into one section of the school. An interesting design feature is the core of 15 classrooms, surrounded on all sides by other rooms. The fuel savings realized from this "insulated" core help defray the added expense of cooling the entire summer school section. The engineers concentrated all mechanical service equipment beneath this section to eliminate long air conditioning channels. Double ducts and automatic controls were carefully designed for easy switchover to cooling and to take full advantage of tempered return air and outside air during spring and fall seasons.

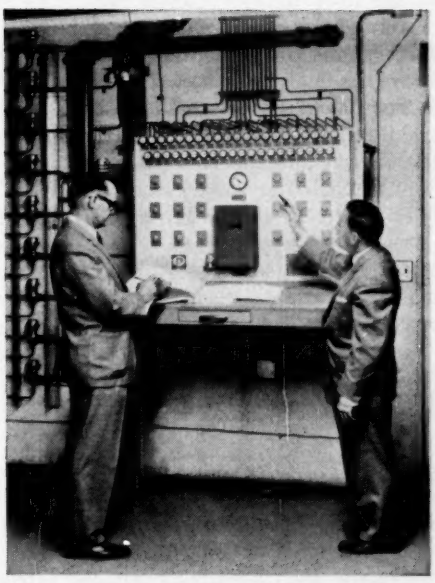


Ceiling Panel Condensation Control

To back up the mechanical efficiency it so carefully designed into the heating, cooling and ventilating system, the Perkins & Will firm specified a Powers system of pneumatic temperature control, including the important dew point control which acts on the chilled water auxiliary cooling used in rooms exposed to the outside. This control (see diagram) utilizes a Powers Water Mix Valve on the ceiling panel chilled water supply and a low limit Submaster Regulator. The Powers Hygrostat measures room humidity conditions and resets the low limit temperature to prevent condensation on panel surfaces, yet allows supply water temperature to be as low as possible for maximum cooling.

Fuel savings in all zones, including those not cooled, are maintained with Powers Day-Night zone controls. A 7-day program clock on the master control panel in the boiler room provides easy switching from day cycle to night cycle. This Powers pneumatic control panel automatically provides a 24-hour-a-day picture of temperature levels in all zones.

Write for the latest Powers Catalog of efficient, economical pneumatic controls for schools and other structures.



Homewood-Flossmoor Maintenance Superintendent William C. Drews (left), takes readings from the automatic Powers pneumatic control panel.

THE POWERS REGULATOR COMPANY
DEPT. 261, SKOKIE 82, ILLINOIS
Offices in Principal Cities in U.S.A. and Canada
MANUFACTURERS OF THERMOSTATIC CONTROLS SINCE 1891
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What Readers Say:

Location of Wall Outlets

EDITOR, AIR CONDITIONING, HEATING AND VENTILATING

Your article on Room Air Distribution in your November, 1960 issue is excellent but it fails to supply information on questions that I have regarding the location of air outlets and returns.

In designing a year-round system, I am interested in warm air distribution for winter heating. I want to locate an outlet 6½ ft high for best results. If I mounted a diffuser this high on an exterior wall with the return on an interior wall, would I be creating a flow of cold air across the bottom of the room which would result in objectionable draft? Would it be better to mount the diffuser on an interior wall with the return on an exterior wall for a high level outlet such as I plan to use?

Rahway, N. J.

The article referred to was prepared by engineers of Carrier Corp., and the problem was submitted to that company. The following letter was received:

EDITOR, AIR CONDITIONING, HEATING AND VENTILATING

Your question, which was not explained in the article on Room Air Distribution, has prompted the following comments. The best results, based on the methods you propose, will be gained by locating the supply outlets at the inside wall and the return grille at the floor in the exterior wall.

Actually, neither of these methods are very satisfactory based on the fact that the outlet is 6½ ft above the floor. If you can possibly get the outlet down to floor level, do so for heat rises. High wall outlets create a noticeable temperature differential between the ceiling and the floor.

A much better arrangement than the one proposed is to locate the supply grille below the window or windows with the return on the interior wall. Since the cold layer comes from downdraft off the window, this must be trapped by a return under the window or an outlet under the window. The latter is preferred.

Howard F. Canning

Carrier Air Conditioning Corp.
Syracuse, N. Y.

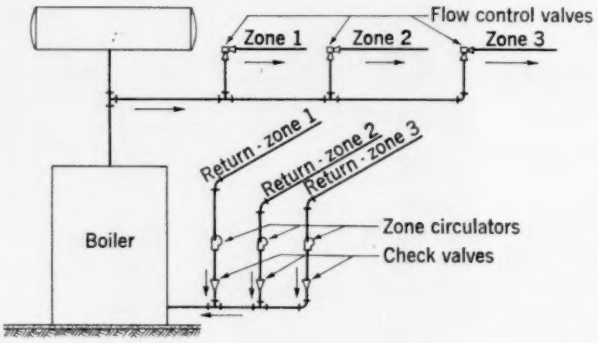
Hydronic Heating Design

EDITOR, AIR CONDITIONING, HEATING AND VENTILATING

A great deal of good design information was contained in Mr. Emerick's article (December 1960), "Hydronic Heating Design for Commercial and Industrial Buildings." In general it was up to the customary high standard of all articles in your publication.

However, there is one point on which I would like to see a little clarification. In connection with Fig. 8 (shown herewith) the text states: "If . . . two or more pumps discharge into a common header, a check valve *or* flow control valve is essential on each discharge."

Am I not right in thinking that both a check valve *and* a flow control valve are necessary on each discharge? If check valves only are used, my reasoning



is thus: When any pump is started, its pressure is transmitted to the supply header and so to any of the zones. True, the zone line corresponding to the operating pump will offer the least resistance and the bulk of the flow will be through it. However, the other lines are not blocked, merely restricted, and proportional flow will occur through each of the other zones. Flow control valves, which I construe to mean motor-operated (not solenoid) are required at the inlet to each zone.

If the zones are all heating zones, no great hardship will be incurred by this slight flow. However, if one zone serves to heat domestic hot water, its operation during the summer may result in undesired circulation in the space heating zones.

Harold Ginzler

Assoc. Mech. Engineer
City of Los Angeles
Los Angeles, Calif.

A copy of the letter written by Mr. Ginzler was sent to Mr. Emerick for his comments. The author's reply follows:

EDITOR, AIR CONDITIONING, HEATING AND VENTILATING

Mr. Ginzler is correct in finding a check valve *and* a control valve necessary when two or more pumps discharge into a common header, with the check valves on the pump discharges and the flow control valves being mounted on the branch to each zone. This combination of checks and flow control valves is shown in Figure 8.

My wording is not as clear as it should be in the sentence, "If the layout calls for 2 or more pumps to discharge into a common header, a check valve or flow control valve is essential on each discharge." In

(Continued on page 10)

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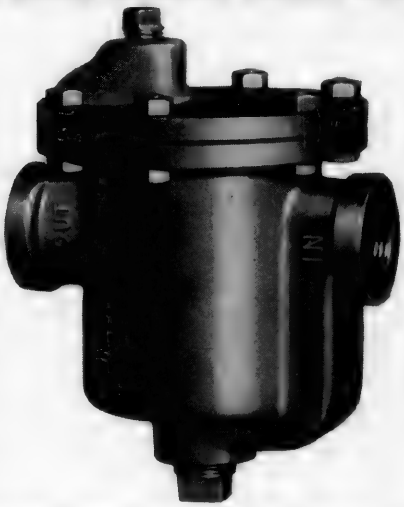

Hoffman Bucket Traps drain intermittently. Featuring stainless steel interiors and straight-through pipe connections. Available with various sized pins and seats for a wide range of pressures.

TRAPS

drain condensate and air from steam lines and equipment

Get maximum efficiency from your equipment and steam lines! Hoffman Traps are precisely engineered to drain condensate and air into return lines. Thus, active steam can continue to circulate and work effectively . . . steam lines and equipment can operate at peak efficiency. Traps shown are just two of the Hoffman Complete Line of quality-tested Steam Traps . . . low, medium and high pressure Thermostatic Traps, Float and Thermostatic Traps, and Inverted Bucket Traps.

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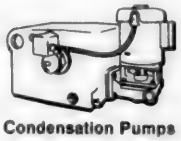
Radiator Traps

Flow Control Valves



Condensation Pumps

Zonal Valves

Float Valves

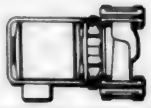
Pressure Reducing Valves

Union Ells

Strainers

Temperature Regulators

Vacuum Breakers



Hot Water Circulators

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VALVES • TRAPS • PUMPS • STRAINERS • REGULATORS

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What Readers Say:

(Continued from page 8)

my mind, at the time of the writing, was the practice of some engineers to set the flow control valves on the inlet side of the boiler; consequently since the pumps are shown discharging into the boiler, we need either a check or flow control valve between the pump and the common header. Practically, of course, a flow control valve designed to block natural circulation is a check valve so it can be used in place of the standard check. In this sense, use of the word "or" rather than "and" is correct.

Under the sub-heading *Reason:* we read, "Similar equipment is required to prevent unauthorized circulation in a group of circuits fed from a common supply, but having individual returns. Figure 8 shows *both* situations."

I certainly might have added a sentence to the effect that Figure 8 represents a method of preventing back flow on the pump discharges, and also illustrates the placement of flow control valves on the supply side of the boiler when several zone branches are taken off a common header.

Unfortunately I did not distinguish between the two separate situations, but in the figure show them as one, and when regarded as one, the word "and" is correct, and the "or" is wrong.

Actually the flow control valves on the boiler discharge will operate on the natural circulation differential only, since the line pressure produced when any one pump comes on the line will keep the check valves closed on the discharges of the non-operating pumps and thus work against the creation of flow through these non-operating circuits.

Even without the flow control valves on the supply branches, circulation through a non-operating circuit would be relatively slight, as Mr. Ginzler points out, since the active circuit offers the least resistance. However, it's a good idea to stop even that minor movement; therefore use of the flow control valves is proper.

I appreciate Mr. Ginzler's letter on this subject, and hope that his question is answered satisfactorily.

Robert H. Emerick
Consulting Mechanical Engineer
North Charleston, S. C.

Psychrometric Charts

EDITOR, AIR CONDITIONING, HEATING AND VENTILATING

With the publishing of the three letters that have appeared over the psychrometrics of Prof. Hedlin's article on greenhouse cooling, I hope it has planted the seed to do something about our psychrometric charts in the fog region.

If you will read through all three letters that have appeared you will note that everyone has an apology or qualification. I suppose Prof. Hedlin* and Mr. Ramsey† will continue to use the charts in their way and I shall use it my way until such time as someone recognizes the fact that "nothing should stop at the saturation line" to paraphrase Mr. Ramsey, and the charts should not leave it to the imagination of each user to decide which way a process should be shown.

Instead of the three of us trying to show where each other is wrong, we should see where each other is right, and do something to clarify a "foggy" situation.

James Marshall
Consulting Engineer
Elkins Park, Pa.

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* *Applying Weather Data to Greenhouse Cooling*, C. P. Hedlin, Associate Professor, Department of Engineering Science, Ontario Agricultural College, Guelph, Canada, ACH & V, April 1960.

† M. A. Ramsey, Consulting Engineer, Air Conditioning Division, Worthington Corp., East Orange, N. J.

Measuring Space Temperatures

EDITOR, AIR CONDITIONING, HEATING AND VENTILATING

This letter is written to comment on the article published in your September, 1960, issue entitled "Measuring Space Temperatures for Comfort Control" by Howard Nordeen.

Mr. Nordeen's article is a well written one, but seems designed to discourage the use of what he calls unit-mounted thermostats. It is true that the application of unit-mounted thermostats as opposed to "on the wall" thermostats is quite limited. The article should have recognized this and confined its discussion to those areas where unit-mounted controls are applicable and are recommended by many of our country's foremost consulting engineers. Because he did not do this, many of his general statements appear to be factual, but merely serve to cloud the issue.

While there are other instances of unit-mounted thermostats, the place where they are widely used and where the major points of disagreement are presently being argued, is in the school classroom for controlling unit ventilator equipment. The real point in issue is then, "where best to locate a thermostat for control of modern classroom unit ventilator equipment"? This is definitely a subject worthy of debate because I can think of no other temperature control application which is so universally encountered, that places such an extreme demand on the temperature control system. . . .

In programming school temperatures it is often desirable to utilize reduced temperature in the building at night. After a period of twelve hours or so at this depressed temperature, building walls dissipate heat and approach the temperature of the night thermostat setting. As operation is resumed at normal daytime temperature, the "on the wall" thermostat is in close proximity to a large surface whose temperature may be 10 degrees or more below the daytime control point. It is impossible to prevent the flywheel effect of the wall mass from affecting control operation of these "on the wall" thermostats. Although the occupied space in the room reaches a comfortable temperature within an hour after day operation is resumed, the walls may require several hours. Often until after the middle of the day, before they reach room operating temperature. This cold wall effect on the ther-

(Continued on page 184)

The Martin Company

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TITAN Vertical Test Facility
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Phillips, Carter and Osborn
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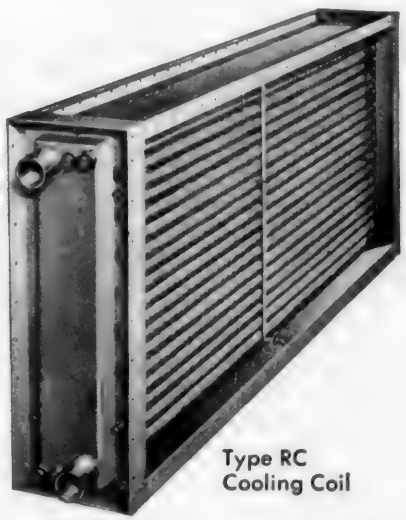

Type RC
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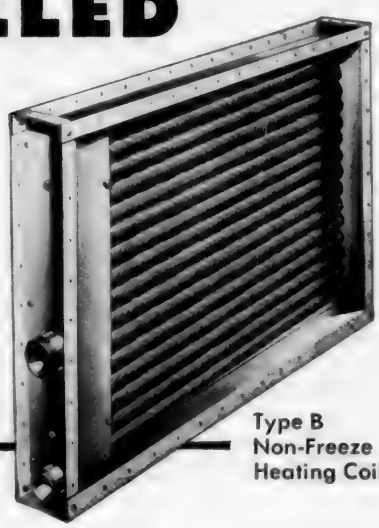

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Aerofin is sold only by manufacturers of fan system apparatus. List on request.

ENGINEERING OFFICES IN PRINCIPAL CITIES

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NEWS OF THE MONTH

CALIFORNIA COUNCIL CONSIDERS LICENSING OF ITS CONTRACTORS

A special meeting of the recently formed California Joint Training Council of the refrigeration and air conditioning industry will discuss this month proposed legislation calling for greater responsibility by contractors under the California License Law. In addition, union and contractor representatives of the Council will take up the matter of licensing and bonding of air conditioning and refrigeration contractors.

The licensing and bonding proposal was recently made by Peter T. Schoemann, general president of the United Association, AFL-CIO, as a means to protect responsible contractors as well as the general public from unqualified contractors. The statewide Council is composed of representatives from local RACCA and UA chapters. A major purpose of the group is to develop joint training programs for apprentices and journeymen throughout the state.

NEW LOOK — Logan T. Johnston (seated), president, and W. B. Quail, vice-president, distribution, Armco Steel Corporation, examine reproductions of their company's triangular-shaped trademark dating back to 1914. The new mark was introduced in all advertising and promotional activities of the corporation.

ASHRAE Closing Cleveland Laboratory; Society to Sponsor Research by Others

Following serious study and long consideration, the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE), New York, N. Y. has decided to continue research through an expanded grants-in-aid program to colleges and private laboratories and to close its Laboratory in Cleveland, Ohio, the Society announced.

This action, voted upon at a recent meeting of the Board of Directors in Chicago, followed the recommendations of the Society's Long Range Planning Committee, which had carefully analyzed ASHRAE's research activities for six months.

In announcing this decision, Walter A. Grant, president, stated: "The Society will, in future, greatly expand its program of research grants and cooperative and sponsored contracts to replace the program at Cleveland which has comprised, by far, the largest portion of our research activity in the past." He outlined five recommendations of the Long Range Planning Committee, designed to assure a research program geared to meet the Society's future needs, also to fulfill more adequately ASHRAE's responsibilities to the public, and to respond to the varied interests of the Society's more than 18,000 members. These recommendations are:

(1) Continue a vigorous research program. (2) Discontinue the Society's Laboratory at Cleveland and dispose of it as soon as is practicable. (3) Conduct and sponsor research at universities and other established laboratories. (4) Use Society general funds for Society administration of the research program and the publication of research. (5) Use a Society Research Fund to finance research work through grants to universities and contracts with private laboratories.

ASHRAE and its predecessor societies have conducted research programs since 1917, contributing outstanding achievements in the fields of heating, refrigerating ventilating and air-conditioning. At the present time, the Society is sponsoring eleven research projects at nine colleges throughout the country.

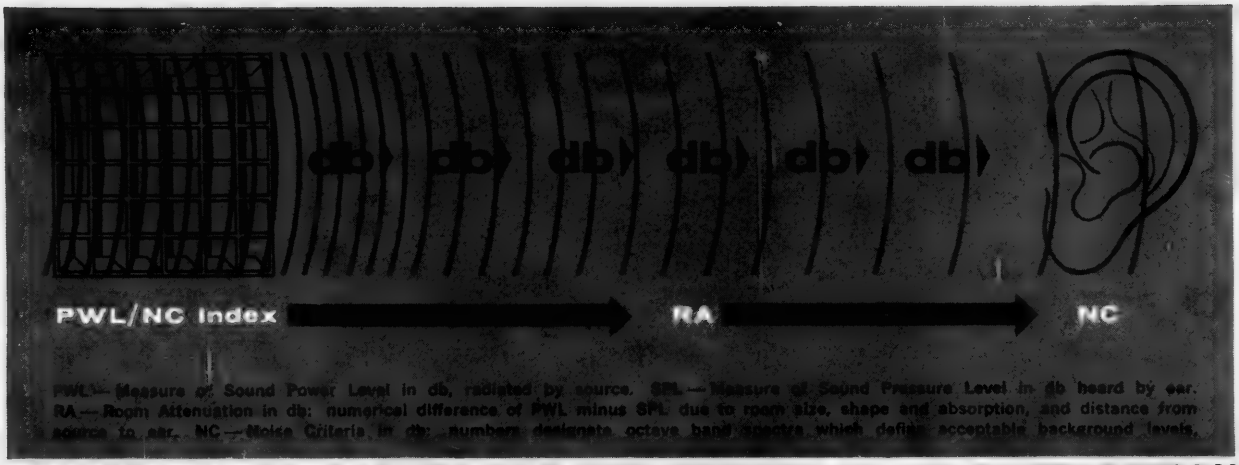
LP Gas Pipeline Now in Full Operation; Minnesota and Wisconsin Terminals Opened

With the opening of its northern-most terminals in Minnesota and Wisconsin early in December, 1960, the nation's first major LPG (liquefied petroleum gas) pipeline, operated by Mid-America Pipeline Company, of Tulsa, Okla., is in full operation, Robert E. Thomas, president of the company said.

Building of the 2,200 mile, $71,000,000, pipeline was begun on April 25, 1960, from supply sources in Western Texas and Eastern New Mexico to outlet terminals as far north as the Twin Cities area in Minnesota and Janesville, Wisconsin, near Madison, with intermediate terminals at strategic locations. While deliveries will be made into a somewhat larger area, the eight states of Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota and Wisconsin are the primary service area of the pipeline system.

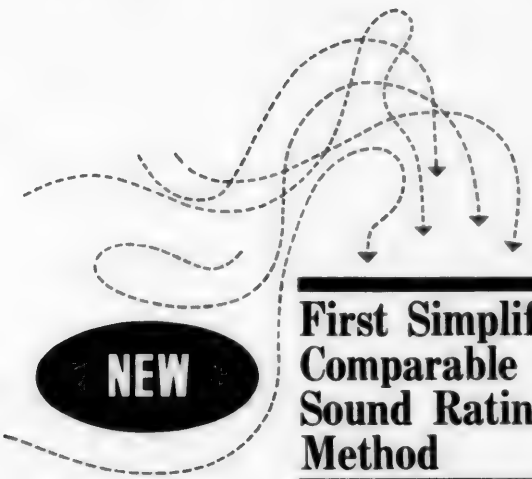
The pipeline, operating as a

(Continued on page 14)



PWL—Measure of Sound Power Level in db, radiated by source. SPL—Measure of Sound Pressure Level in db heard by ear. RA—Room Attenuation in db: numerical difference of PWL minus SPL due to room size, shape and absorption, and distance from source to ear. NC—Noise Criteria in db: numbers designate octave band spectra which define acceptable background levels.

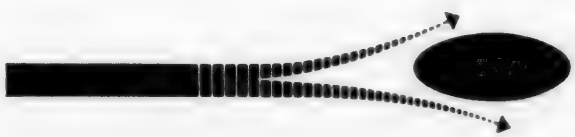
LEADERS GO TO CARNES FOR THE NEWEST IN AIR DISTRIBUTION



NEW

First Simplified Comparable Sound Rating Method

NEW



NEW

NEW

NEW

PWL/NC INDEX

CARNES PUBLISHED ITS NEW CONCEPT IN 1959.

The old rating method of judging units — based on the "A" Scale or Sound Pressure Level (SPL) as heard by the ear from a non-standard distance in a non-standard room . . . yielded non-comparable values, and for comparable rating of manufacturers' units is all but useless.

Carnes' method eliminates these variables and rates the Sound Power Level (PWL) radiated by the source at the source. This workable, simple, easy to use method permits establishing a single number for rating performance, yet covers the pertinent information which makes the octave band analysis desirable. PWL/NC Index is a number assigned to the PWL spectrum of a unit (when discharging a specified CFM) which indicates the minimum NC(PWL) curve that will not be exceeded in any band. The NC(SPL) curve which will not be exceeded in any band will be the PWL/NC Index minus Room Attenuation. Carnes' facilities and techniques are in accord with the standards which have been proposed by the ASA and ASHRAE. Write for complete details on Carnes published Sound Rating Method.

Carnes manufactures High and Low-Velocity ATC Units • Modular, Round, Rectangular, Square, Convertible and Baseboard Diffusers • Registers • Grilles • Roof and Wall Ventilators.

CARNES CORPORATION, VERONA, WISCONSIN, / CANADIAN SUBSIDIARY: WEHR AIR EQUIPMENT COMPANY, LTD., 86 GERTIE STREET, WINNIPEG 2, CANADA

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LP GAS PIPELINE

(Continued from page 12)

common-carrier for propane, butane, and natural gasoline, has an extensive gathering system in the West Texas-Eastern New Mexico region. The main trunk line originates near Hobbs, N. M.

According to Mid-America, supply and marketing areas of the line will be served for the first time with a large-volume, dependable, efficient facility for transporting these products. It will be a force for increasing the use of LPG, for changing transportation and distribution patterns, and for attracting new industry, especially petrochemical plants, to the area.

Initially, the system primarily will handle large volumes of propane, but gradually shipments of butane and natural gasoline as feed stocks for refineries — and eventually shipments of propane and butane for petrochemical plants — are expected to become important.

Mid-America Pipeline Company route map of area served by new 2200-mile pipeline for transporting liquefied petroleum gases from Texas and New Mexico sources.

The system includes gasoline plant connections and gathering lines, operating terminals, delivery terminals, operating storage facilities, and control, measurement, dehydration and dispatching equipment. Operating terminals are located at the Texas-New Mexico border near Hobbs, N. M., and Conway, Kan. with large underground storage facilities at Hobbs and Conway.

A central dispatching board controlling the entire system operations is located in the general offices at Tulsa. The pipeline is generally of 8-inch diameter. Trunk will deliver up to 60,000 barrels per day.

CERTIFICATION PROGRAM FOR ROOM CONDITIONERS ADOPTED

Manufacturers of room air conditioners, through their Section in the National Electrical Manufacturers Association, New York, N. Y., will launch a voluntary certification program under which they will certify the cooling and/or heating performance of their products to purchasers, starting with 1962 models.

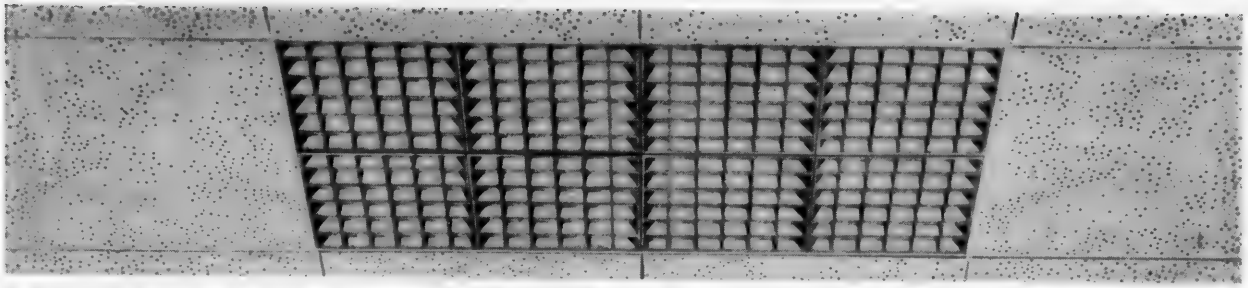
Certification will be based on models which have been accurately tested and rated in accordance with NEMA Air Conditioner Standard—CNI—1960. The testing will be under the supervision of Electrical Testing Laboratories Inc., New York, N. Y.

The activity is the most comprehensive and strongest voluntary testing project that can be adopted within the facility limitations of manufacturers and independent laboratories combined, NEMA states. Because of the importance of the activity to the general public, the Section will permit nonmembers as well as members to participate. In addition, manufacturers producing room air conditioners for wholesale or retail outlets under special brand names may have such products tested for certification under the NEMA program. These two latter moves open the certification plan to all manufacturers of room air conditioners and provide purchasers with accurate evidence of the performability of their equipment.

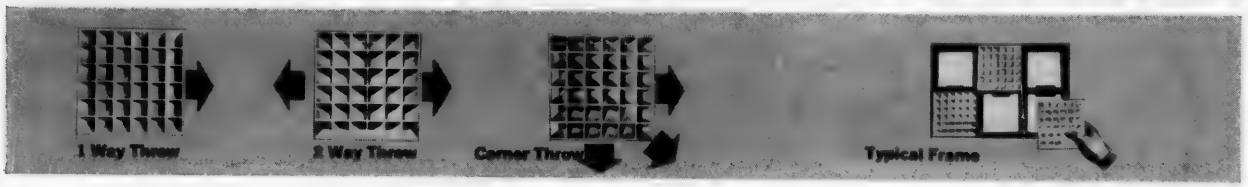
Original participants in the plan, all member companies of the NEMA Room Air Conditioner Section, are:

Admiral Corporation; Airtemp Division, Chrysler Corporation; Amana Refrigeration, Inc.; Kelvinator Division, American Motors Corporation; Coolerator Division, McGraw-Edison Company Fedders Corporation; Emerson Radio and Phonograph Corp.; The Emerson Electric Manufacturing Co.; Frigidaire Division, General Motors Corporation; General Electric Company; Hotpoint Company, A Division of General Electric Company; I. W. Air Conditioning Corporation; Philco Corporation; Westinghouse Electric and Whirlpool Corporations.

(Please turn to page 16)



LEADERS GO TO CARNES FOR THE NEWEST IN AIR DISTRIBUTION



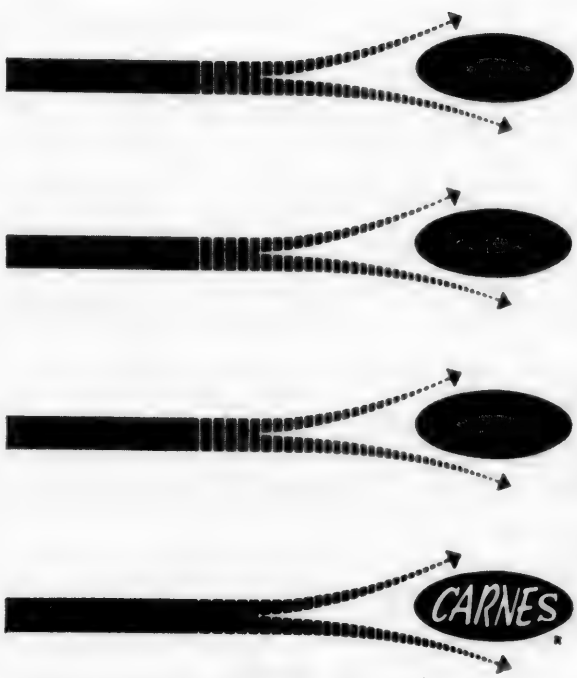
NEW

Modular Diffuser patent applied for

FUNCTIONAL! VERSATILE! UNOBTRUSIVE!

Carnes attractive white Model "M" Modular Diffuser enhances the aesthetic quality of any ceiling. The 6-inch square modules fit virtually flush with ceiling . . . have a minimum of see-through . . . inhibit smudging . . . easily slip in or out for changing air direction or cleaning. An infinite number of patterns and sizes are yours by combining multiples of three modules: 1 way throw, 2 way throw, corner throw. Continuous strip patterns . . . cross patterns . . . alternating patterns may be developed to solve any design or air distribution problem. Module units . . . above windows . . . between fluorescent fixtures . . . around columns or walls . . . butted to light fixtures . . . carry out architectural lines and blend with all ceiling materials. They are equally effective when used as an air return. Modules are made from General Electric's revolutionary new LEXAN, a self-extinguishing, high-impact material that withstands temperatures to 225° without distortion. Frames are available in a wide variety of sizes and types . . . easily joined to make any continuous length or width desired. For complete details, write for Modular Diffuser Catalog No. 480.

Carnes also manufactures Round, Rectangular, Square, Convertible and Baseboard Diffusers • Registers • Grilles • High- and Low-Velocity ATC Units • Roof and Wall Ventilators



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1961 Construction Peak Forecast; Assume Over-all Upturn in Last Half

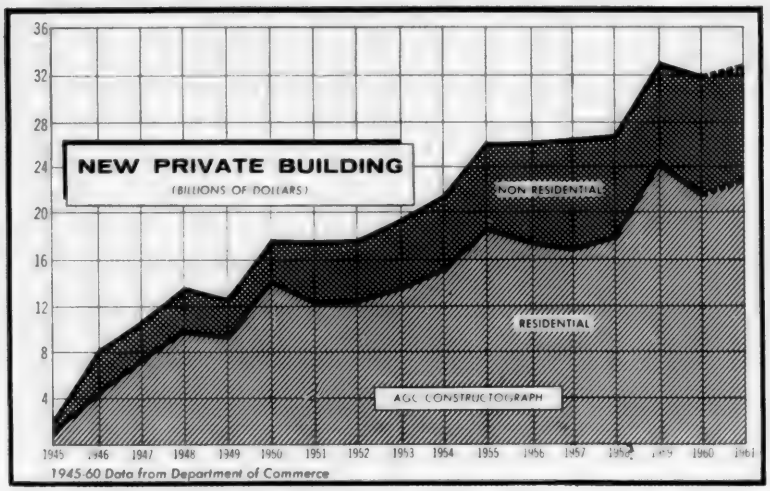


Fig. 1—New private building should increase considerably in 1961, with nonresidential categories showing a larger gain than residential construction. In 1960 the rise in nonresidential buildings did not quite offset the big drop in residential construction.

NEW CONSTRUCTION PUT IN PLACE IN THE UNITED STATES, 1959, 1960, AND OUTLOOK FOR 1961*

Type of Construction	Value in Millions of Current Dollars 1959 Actual	1960 Estimate	1961 Forecast
Total New Construction	$56,233	$55,100	$57,275
Private construction	39,892	38,900	40,275
Residential buildings (nonfarm)	24,469	21,950	22,800
Nonresidential buildings	8,859	10,075	10,475
Industrial	2,106	2,900	3,000
Commercial	3,930	4,050	4,200
Other nonresidential	2,823	3,125	3,275
Farm construction	1,362	1,300	1,325
Public utilities	4,995	5,275	5,375
All other private	207	300	300
Public construction	16,341	16,200	17,000
Residential buildings	962	725	750
Nonresidential buildings	4,514	4,800	5,200
Military facilities	1,488	1,325	1,325
Highways	6,000	5,700	6,000
Sewer and water systems	1,467	1,500	1,500
Public service enterprises	551	650	650
Conservation and development	1,130	1,275	1,325
All other public	229	225	250
Maintenance and repair	19,300	19,000	19,500
GRAND TOTAL	75,533	74,100	76,775

* Source: Statistics for 1959 and 1960, except 1960 maintenance and repair estimate, U. S. Department of Commerce. Forecast for 1961, and 1960 maintenance and repair estimate, Associated General Contractors of America.

Construction volume, after faltering in 1960 for the first time since the end of World War II, is expected to rise to an all-time peak of 76.8 billion in 1961, thereby providing a major thrust in helping boost the national economy out of a downturn for the fourth time in the postwar years.

This estimate, announced by the Associated General Contractors of America in the January issue of its magazine, *The Constructor*, is about 3½% above the $74.1 billion total estimated for 1960, and also tops the previous dollar volume record of $75.5 billion of construction put in place in 1959.

The forecast in the AGC's annual review and outlook statement is divided into $57.275 billion of new construction and about $19.5 billion in maintenance and repair operations, compared with the 1960 totals of $55.1 billion and $19 billion, respectively. (Breakdown by categories is shown in table. See, also, Fig. 1.)

Private Building to Increase

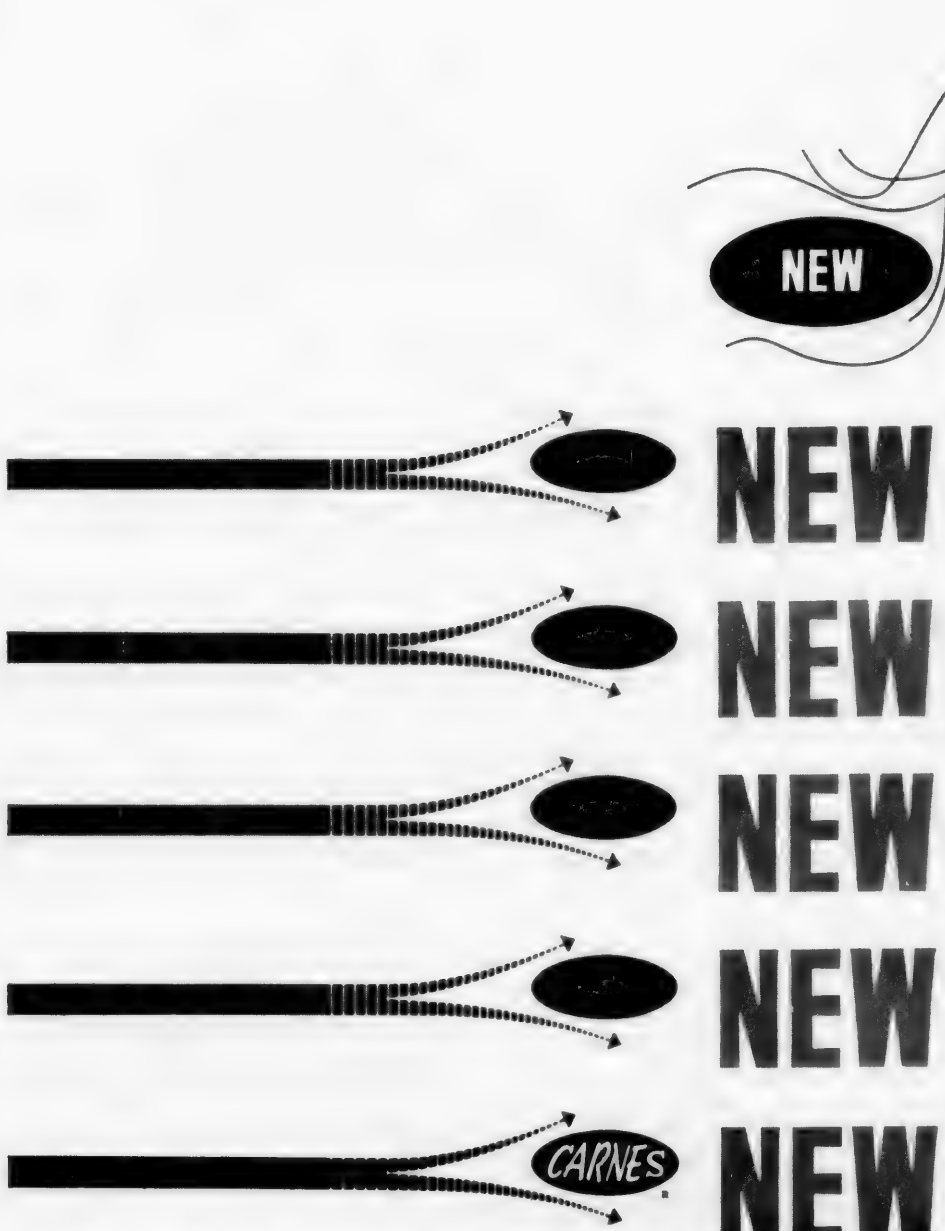
The year is expected to be characterized by a partial recovery in housing activity, a continued increase in the high level of private nonresidential building, and rises in virtually all categories of public works. Public construction, propelled by the record-breaking volume of bond issue proposals approved by voters in 1960, will be dominated by state and local public works projects.

Basic assumptions attached to the 1961 outlook are that over-all economic activity will turn upward in the second half of the year after overcoming the current lag in the first half; that construction costs will remain stable; that no prolonged work stoppages will occur in basic industries; and that international complications will not adversely affect domestic construction, AGC said.

(Please turn to page 18)

Carnes engineers lick high-velocity split service problems with new simplified all-pneumatic constant volume control. Only Carnes new Acoustic Terminal Control Units offer all these features: positive temperature mixing with integral blender; full acoustic baffling; inch-thick acoustic lining; metal protection on leading edges of lining; flow path not obstructed by perforated material; accurate pressure-drop sensing tips; non-stick, leak-free resilient valve seats. 3 ATC ceiling models — end discharge . . . bottom discharge . . . multi discharge. 2 ATC window/perimeter models — front discharge . . . top discharge. All models are available in single or dual duct with full control selection.

LEADERS GO TO CARNES FOR THE NEWEST IN AIR DISTRIBUTION



NEW

High-Velocity All-Air ATC Units

Carnes Acoustic Terminal Control Units feature new simplified all-pneumatic constant volume control with direct valve to motor connections, eliminating troublesome mechanical devices such as curtains, flappers, bladders, linkages. Carnes new ATC Units assure trouble-free lifetime operation. Investigate now. Write for ATC Catalog No. 1160.

Carnes also manufactures: Low-Velocity ATC Units • Modular, Round, Rectangular, Square, Convertible and Baseboard Diffusers • Registers • Grilles • Roof and Wall Ventilators.

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SEPARATE HOT, COLD MOLECULES FOR AIRBORNE EQUIPMENT COOLING

Direct air cooling of electronic equipment in supersonic aircraft may yet be accomplished despite the considerable rise in air temperature due to shock compression. In fact, shock compression supplies the only power required to operate the Hilsch vortex tube 'refrigerator' now under development at the Heat Transfer Laboratory of The Hallicrafters Co., Chicago, Ill.

The Hilsch vortex tube acts like a cream separator, except that it has no moving parts. Its function is to separate the lower energy (lower temperature) molecules of a stream of compressed air at elevated temperatures.

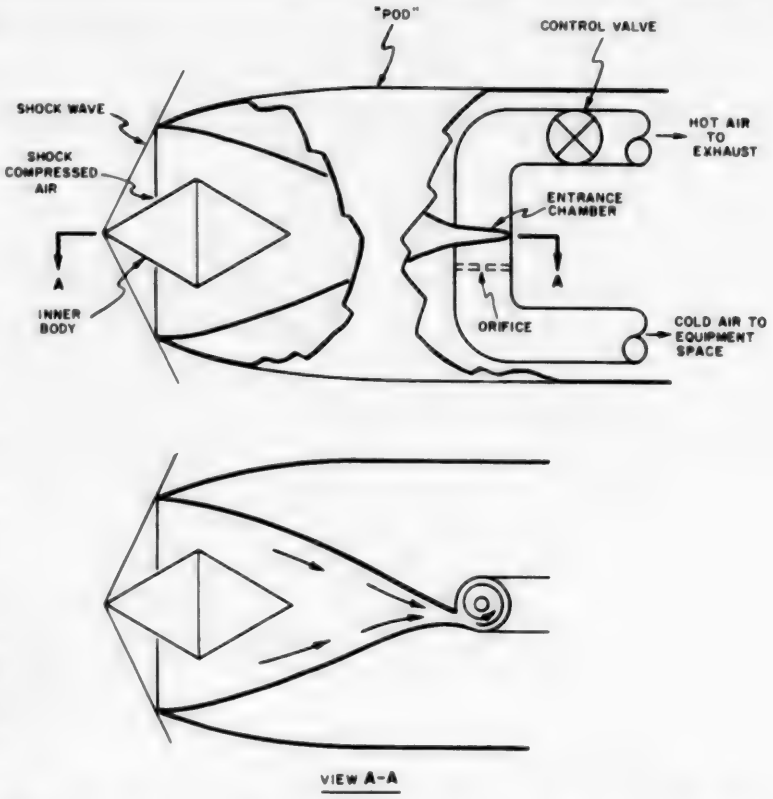
Equipment to be cooled will be housed in a "pod" attached to the aircraft (see sketch). An inlet resembling that of a ram jet engine will admit shock compressed air to the Hilsch tube. Air enters the tube tangentially and is spiralled into a vortex.

A strategically placed orifice bleeds off the low energy particles for equipment cooling while the hotter high energy air particles are exhausted outboard. A valve in the hot line controls the relative air flows, effectively regulating the air temperature downstream of the orifice.

With an ambient air temperature of 60 deg F, the stagnated Hilsch tube inlet air temperature of an aircraft at Mach 2, sea-level altitude, is 474 deg. Based on the Maxwell-Boltzman distribution of air molecule velocities under these conditions, Hallicrafters engineer Richard L. Turner has demonstrated that 65% of the air molecules accepted by the Hilsch tube have a mean velocity corresponding to an air temperature of 131 degrees.

Ideally, 1.0 lb of air per minute at 131 deg can be extracted from every 1.54 lb per min of air at 474 deg entering the vortex tube.

Allowing for considerably less than ideal performance, Hallicrafters believes the simplicity of the Hilsch vortex tube promises sufficient savings in weight, space, power and cost over mechanical refrigeration systems to become a strong contender for consideration in future aircraft designs.



Schematic diagram of Hilsch vortex tube developed by The Hallicrafters Company for cooling electronic equipment in supersonic aircraft.

USSR PREFABRICATES BATHROOM PLUMBING CONTRACTOR REPORTS

In the course of a recent trip, William P. Scott, Jr., past president of the Oakland, California chapter of Mechanical Contractors Association of America, Inc., was able to observe the state of plumbing and heating in most of the major countries of Europe. His comments were reported in the *Bulletin* of the National Association of Plumbing Contractors, Washington, D. C.

Because of his official standing in the construction industry in the United States, Mr. Scott was able to visit a fabrication plant in Leningrad and in Kiev.

"The Russians are prefabricating apartment houses on a massive scale", he reported. Mr. Scott believes that their workmanship in the shop was good, but that their workmanship in the field was below our standards.

"In the shop they are prefabricating whole bathrooms — walls, floors, ceilings—complete with all piping and ready for installation. They are using jigs which are quite similar to procedures used in this country. However, it was

(Continued on page 168)

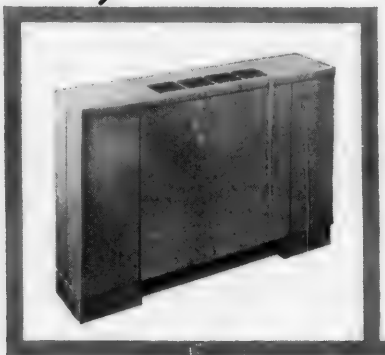
C'EST SI BON...

BOHN-AIRE

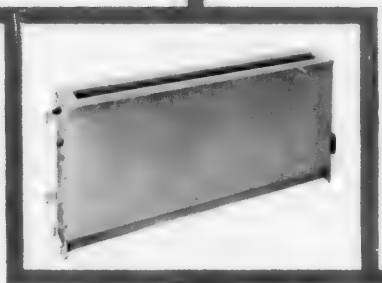
means COMFORT

in any language...

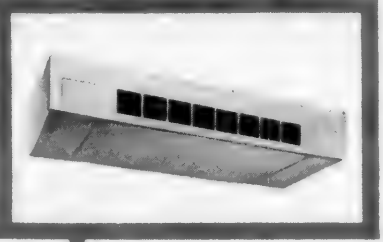
in any season!



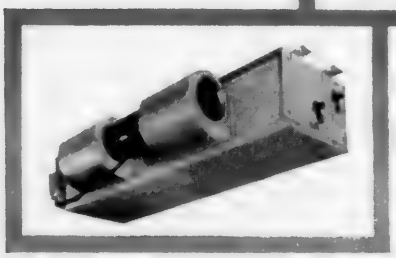
MODEL B-D for vertical floor mounting "in-the-space" or semi-recessed up to 3½".



MODEL B-V for vertical concealed floor mounting.



MODEL B-C with finished cabinet for "in-the-space" horizontal mounting.



MODEL B-H for horizontal mounting in concealed locations (plenum optional).

COMPLETE FLEXIBILITY... 4 ROOM CONDITIONERS IN 5 SIZES EACH

Quietly, dependably, BOHN-AIRE Remote Individual Room Conditioners provide year 'round comfort in apartments, motels, hotels, offices, hospitals... in any building with a central hydronic heating and cooling system. They are extremely compact with a slim 8½" width... available in concealed models or in attractive, durable cabinet styles... easy to install and service. Finger-tip push button control! Many optional accessories.

BOHN *Buy the known line... the BOHN line*

ALUMINUM & BRASS CORPORATION

Danville Division • Danville, Illinois

For more data circle this page number on card at back of book

Designed for Architects • Engineers • Contractors

Whatever the architectural specifications, the slim-trim distinctive design of Stripline extruded aluminum slot-type diffusers blends in perfectly with the general decor. Stripline with separate mounting frames and interchangeable cores eliminates screwholes, leaves the decorative surface unmarred.

Stripline is INCONSPICUOUS . . . PRACTICAL, can be located anywhere to suit the interior designer's preference...in walls...ceilings...coves...moulds... window sills. Stripline is supplied as a continuous decorative unit, or in sections, to meet any requirements of interior treatment or airflow.

Unlike side wall grilles and air discharge slots, Stripline diffusers incorporate the exclusive Agitair diffusing vanes. These built-in diffusing vanes produce extremely high turbulence and aspiration... achieve rapid temperature equalization...insure the distribution of tempered air unvaried over a predetermined area without any noticeable air motion.

In the design of Stripline extrusions, top priority was given to solving the contractors installation problems. These units are now made with interchangeable cores and separate mounting frames for surface or plaster installations. An integral part of each diffusing core is the unique coil spring-lock which further facilitates the installation of Stripline when used as a continuous unit or where sections are required. This spring-lock feature locks the unit firmly in place, and eliminates the use of screwholes and screws.

For more information write for
technical catalog ES-105

AIR DEVICES INC.

185 MADISON AVENUE • NEW YORK 16, N.Y.

BETTER PRODUCTS FOR
AIR DISTRIBUTION • AIR CLEANING • AIR EXHAUST

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BUY SPORLAN *Catch-Alls*

. . . the Perfect Filter-Drier for every capacity
from fractional horse-power units to large capacity installations

Sporlan offers a complete range of Catch-Alls engineered to fit every application, from domestic refrigerators, small freezers and vending machines to the largest commercial and industrial refrigeration and air conditioning systems, with every conceivable job size in between.

No matter how large or small the job you are planning, your filter-drier worries stop when you buy Sporlan Catch-Alls.

In addition, the Sporlan Catch-All is the perfect filter-drier because . . .

- Desiccants are molded into a porous core.
- Maximum drying through highest degree of activation.
- Filtering instead of straining.
- Superior acid removal.
- Refrigerant cannot channel through or by-pass around the core.
- Core will not powder or pack.
- Full line flow protection for any size system.
- Connections are protected by moisture and tamper-proof seals.

See your Sporlan Wholesaler for your Catch-All needs today and ask him for a copy of Bulletin 40-10.

See you at
Booth No. 1254
15th INTERNATIONAL
HEATING & AIR CONDITIONING EXPOSITION
Chicago, Illinois February 13-16, 1961

SPORLAN VALVE COMPANY
7525 SUSSEX AVENUE ST. LOUIS 17, MISSOURI

EXPORT DEPT. • 85 BROAD STREET • NEW YORK 4, N. Y.

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WHERE'S THE BOILER?

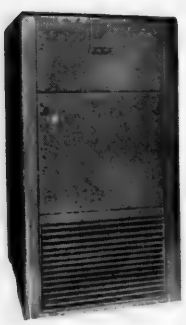
No need to worry about delivery when you use a Weil-McLain *sectional cast iron* gas or oil boiler! Any Weil-McLain boiler, regardless of capacity *can be passed through an ordinary door, section by section!*

In new buildings, construction need not wait for boiler installation; the boiler can be assembled after the job is under roof. In an old building, if a boiler is to be completely replaced, a new Weil-McLain unit can be moved in without tearing out walls.

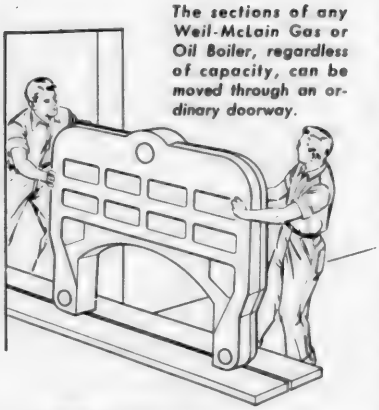
A Weil-McLain boiler also provides a hedge against future needs. If additional capacity is required, a second boiler can be installed to supplement the original boiler...or additional sections installed in the present boiler.

Sectional Weil-McLain boilers offer these additional advantages...less boiler room space needed... longer life because built of corrosion-resistant cast iron...strain-free assembly with short draw rods... tested and rated by I=B=R...easy maintenance.

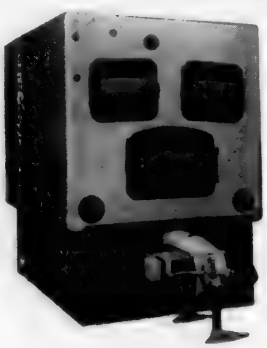
Weil-McLain boilers for commercial, industrial and institutional installations are available for gas, oil, heavy oil, combination gas—light oil, or coal. For full information write Weil-McLain Company, Michigan City, Indiana, or see Engineer's Product File or Sweet's Architectural File.



GAS BOILERS
Capacities to
3,354,000 BTU/hr.



The sections of any Weil-McLain Gas or Oil Boiler, regardless of capacity, can be moved through an ordinary doorway.



OIL BOILERS
Capacities to
2,942,500 BTU/hr.

WEIL-McLAIN

CAST IRON BOILERS

"Boilers with a future"

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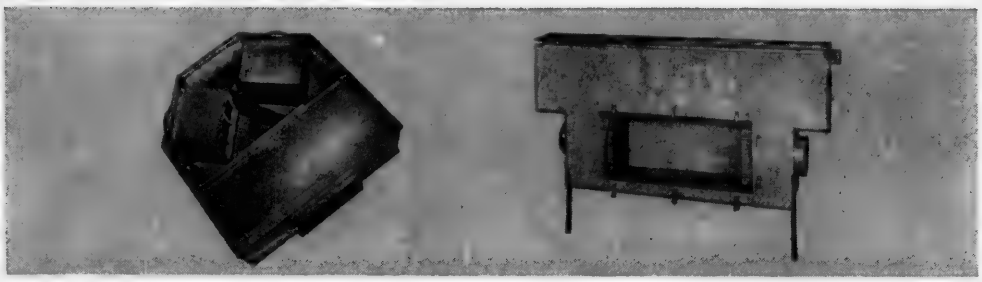
NOW... IN AIR DISTRIBUTION
CONNOR MAKES THE *COMPLETE* CONTRIBUTION

low—medium—high velocity air valves

PNEUMAVALVE—a contribution made only by Connor—adapts with equal facility anywhere that air must be controlled. Needs neither mechanical linkage nor operators. Response is instantaneous, positive, linear. No hysteresis. Minimum turbulence. A range of sizes. Bulletin K-45.

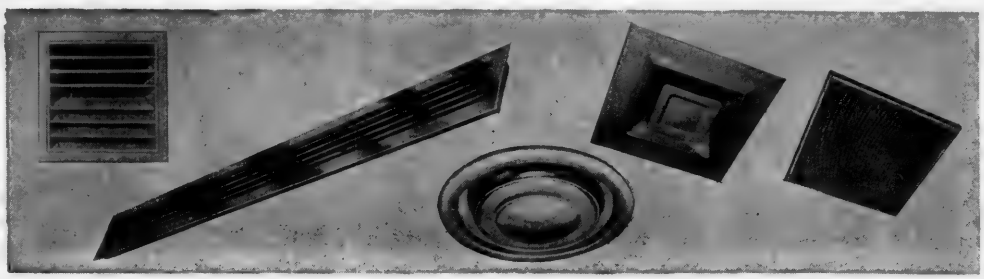
high velocity valve attenuators

At the heart of every model in Connor's Series 45P line is PNEUMAVALVE, the exclusive element that makes this Series superior for fault-free, ultra-quiet, minimum-maintenance performance. Shown are the DPC total constant volume Ceiling unit, left, and the unique DPW total constant volume Under-Window Sill-Slot unit. Bulletins K-33A, K-46, K-52, 31F.



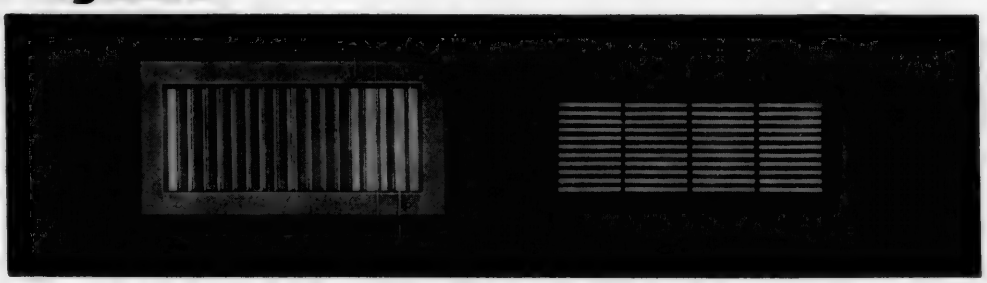
air diffusers

Shown are representative models in the complete Kno-Draft air diffuser line . . . adjustable and fixed pattern. Smart, simple styling that blends perfectly, unobtrusively with any interior, most recent additions are the KSS multi-pattern diffuser, extreme left, and the KO perforated diffuser, extreme right. Bulletins K-20A, K-27A.



grilles and registers

The extensive Kno-Draft line of grilles and registers offers a wide variety of face designs and rectangular configurations. Units that permit two-directional air flow, positive air volume control, other desirable features are available. Bulletin K-40.



SEE THEM ALL AT BOOTH 142, INTERNATIONAL HEATING AND VENTILATING SHOW, FEBRUARY 13-16, 1961.

CONNOR

CONNOR kno·draft® AIR DIFFUSERS

DANBURY • CONNECTICUT

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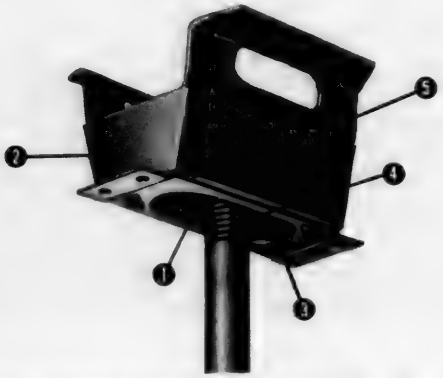
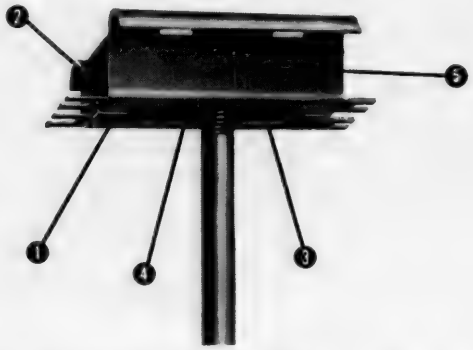
See all the extra features you get in Grinnell Concrete Inserts...at no extra cost!



GRINNELL WEDGE TYPE CONCRETE INSERT (Steel), FIG. 281 — 1. Nut and rod may be preassembled for fast installation 2. Wedge-shaped body compresses in concrete for extra strength 3. Knockout (already removed) seals out concrete 4. Full 1¾ inch lateral adjustment 5. Supports up to 1200 lbs.



GRINNELL LIGHT WEIGHT CONCRETE INSERT (Steel), FIG. 285 — 1. Designed for light-duty use in concrete 2 inches and thicker 2. Arched flanges take reinforcing rods 3. Knockout seals out concrete 4. Full 2 inch lateral adjustment 5. Supports up to 400 lbs.

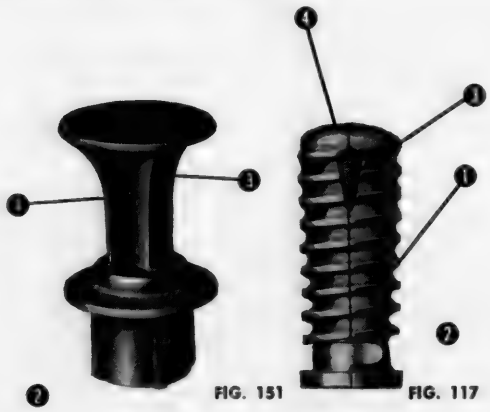
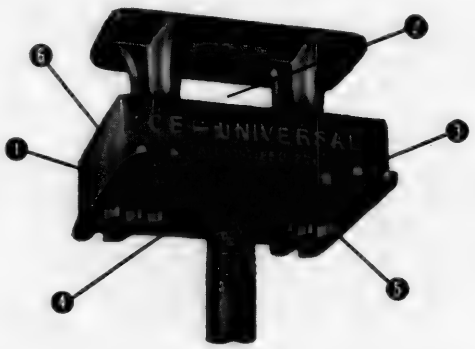


FIG. 151 FIG. 117

GRINNELL SCREW CONCRETE INSERT (Malleable Iron), FIG. 151 — 1. Malleable iron for extra strength 2. Pipe sizes through 12 inches. 3. Supports up to 2,120 lbs. **GRINNELL EXPANSION CASE (Malleable Iron), FIG. 117** — 1. Malleable iron, cadmium plated, assures high resistance to impact, corrosion 2. Pipe sizes through 16 inches 3. Rod moving upward forces wedge-shaped nut downward, expanding and locking case in concrete 4. Supports up to 1300 lbs.



GRINNELL CB "Closed Back" CONCRETE INSERT (Malleable Iron), FIG. 282 — 1. One body size accommodates 5 sizes of rods 2. Slot takes reinforcing rods to assure maximum load rating. 3. One-piece body prevents concrete seepage 4. Teeth on insert and nut hold rod firmly in place 5. Homogeneous composition of malleable iron throughout 6. Supports up to 1430 lbs. (Also available in smaller "CB-JUNIOR" size that supports up to 770 lbs.)

You get *more* for your money from Grinnell, because Grinnell's huge volume reduces production costs . . . lowers prices right into line with competitive inserts offering much less.

Look at all you get with Grinnell Inserts: wider choices of types and sizes . . . better quality control . . . published ratings for *all* inserts! Faster delivery from nationwide warehouses, too. Moreover, you receive dependable field service by trained Grinnell personnel . . . no matter how far from the job site the sale was made! Grinnell Company, 277 West Exchange St., Providence 1, R. I. Branch warehouses in principal cities.

Remember, The Best Costs No More — from America's #1 Supplier of Pipe Hangers and Supports

Call your local Grinnell Distributor for pipe hangers, cast and malleable iron fittings, steel nipples, welding fittings, Grinnell-Saunders Valves, unit heaters – all made by

GRINNELL

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Problem: Paint jobs ruined by airborne dirt in spray booth

This plant needs make-up air! If the exhaust fans in your paint shop remove air faster than you replace it, they cause a vacuum. The vacuum sucks in dirt and dust every time a door or window is opened. Your plant needs make-up air...a supply of new air to replace exhausted air and cancel out vacuum.

Without make-up air, you get a chain reaction of vacuum problems. Violent cross drafts...Infiltration of dirty air or fumes from outside, and from one plant section to another ...Heat loss...Unhealthy workers... Low morale...Costly absenteeism.

Solution: install separate fans to supply make-up air. They cancel out the vacuum, give your plant balanced ventilation. These fans should be part of a complete make-up air system that tempers and cleans the incoming air.

For technical help on make-up air, see your Consulting Engineer. Or call in Sturtevant application engineers. They're experts in handling air...whether you want to move it, heat, cool or clean it. Mail coupon for booklet on make-up air. J-80709

WESTINGHOUSE ELECTRIC CORPORATION
Sturtevant Division, Dept. VCO9
Hyde Park 36, Mass.

Send me your make-up air booklet.

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TITLE_____

COMPANY_____

ADDRESS_____

PHONE_____

Westinghouse

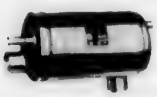
EVERY B&G® COMPONENT IN THIS TYPICAL INSTALLATION IS ALIVE WITH STAR FEATURES

B&G CONDENSERS

Lighter, more compact units, featuring quiet, vibration-free operation, uniform gas distribution, cleanable tubes and higher operating efficiencies.

B&G EVAPORATORS

See illustration at right for features which give these units outstanding superiority.



B&G SUCTION LINE HEAT EXCHANGERS

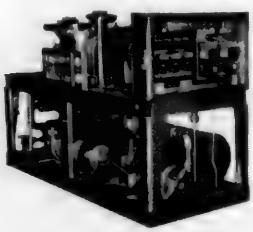
Aid thermal expansion valve operation, prevent liquid slugging.

B&G COMPRESSORS

Precisely engineered for vibration-free operation with all the advantages of "open" units. All units have *one* bore—a few interchangeable parts service them all.

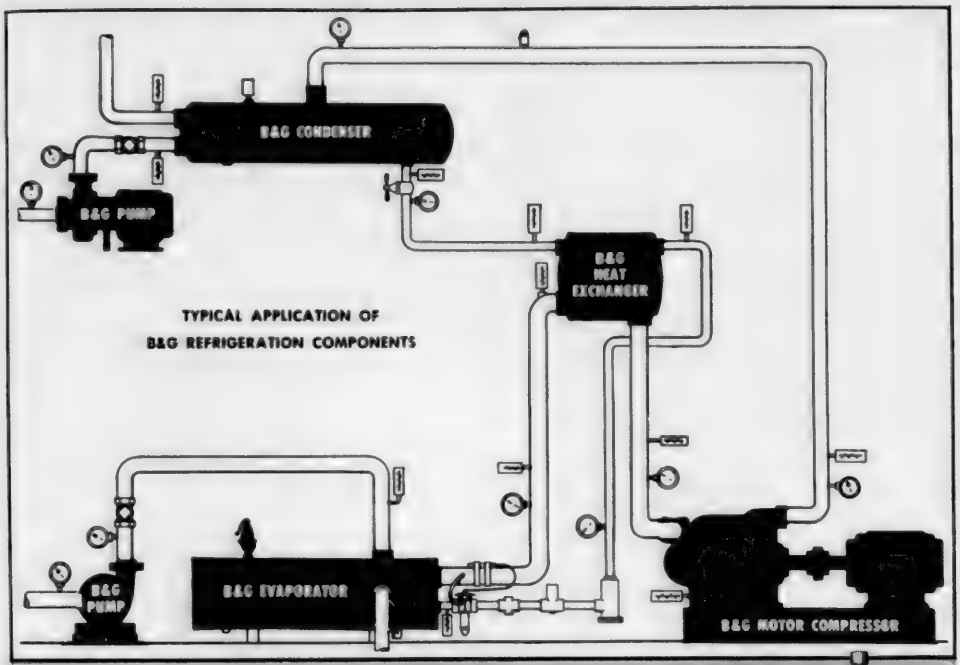
B&G CENTRIFUGAL PUMPS

A full range of *quiet* pumps for refrigeration and air conditioning systems.

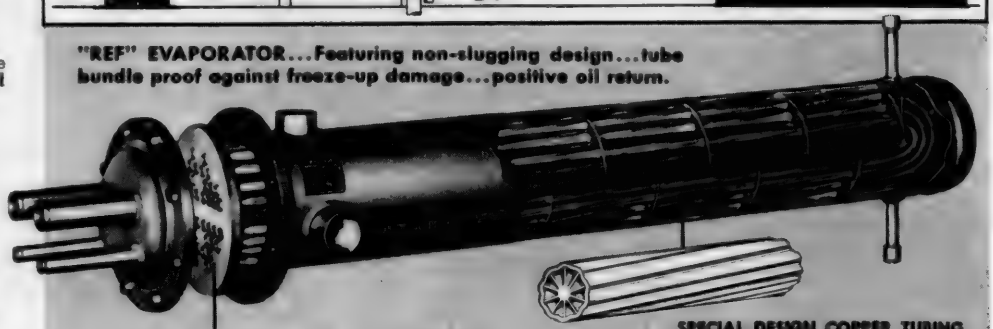


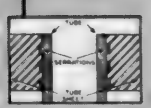
B&G PACKAGE LIQUID COOLERS

A completely integrated and assembled water chiller—the only unit of its kind with all major parts designed, built and guaranteed by one manufacturer.



"REF" EVAPORATOR...Featuring non-slugging design...tube bundle proof against freeze-up damage...positive oil return.





SERRATED TUBE HOLES Assure leak-free joints between tube sheet and tubes

SPECIAL DESIGN COPPER TUBING Fluted tubing provides positive and permanent mechanical bond between tube and inner fin for all temperature variations—positive contact throughout 180° bend. Inner-fin tube triples refrigerant heat transfer surfaces. Centrifugal force created by the twisted spline holds liquid refrigerant against tube, minimizing slugging and pressure drop.

B&G makes a complete line of refrigeration and air conditioning components—*with many commonly used sizes available for immediate shipment from factory stock!*

These are quality units throughout! B&G Evaporators and Condensers all offer *plus values* in efficiency and rugged, long-life construction. They are manufactured by methods which hold shell diameters exact and free of distortion. This permits tight fitting baffles with minimum liquid slippage, greater efficiency and easy replacement of tube bundles if ever necessary.

All units are built to A.S.M.E. Code requirements and are so stamped.

When selecting pumps, B&G Series 1522, 1531 and 1510-B Centrifugal Pumps invite your most critical comparison. They are of vertical split case design, equipped with the exclusive, leak-proof "Remite®" Mechanical Seal and noted for quiet, dependable operation.

BELL & GOSSETT
COMPANY
Dept. RGN-4, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ontario

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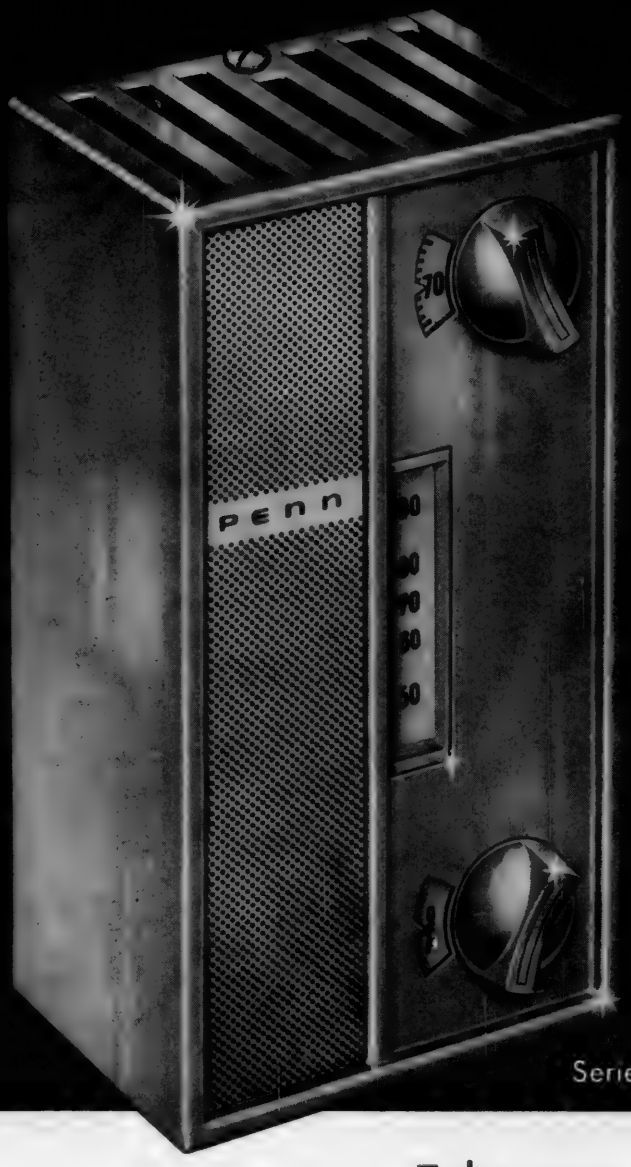
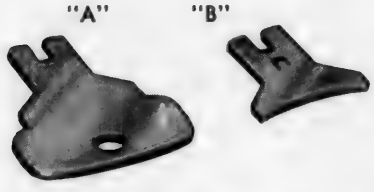


NEW

line voltage THERMOSTAT with front panel control of all heating-cooling functions!

Series 822



How settings are locked

Where it is desirable to lock settings, installer removes cover and pushes out factory-installed key "B" from each adjusting knob. This disconnects knob from adjusting shaft. Then, user may insert special key "A" (supplied for key chain use) through knob slot and turn to make desired settings . . . remove key and thermostat is locked as adjusted.

Take your choice...heating, cooling or heating-cooling...each features unique, easy-to-use, locking-type knobs

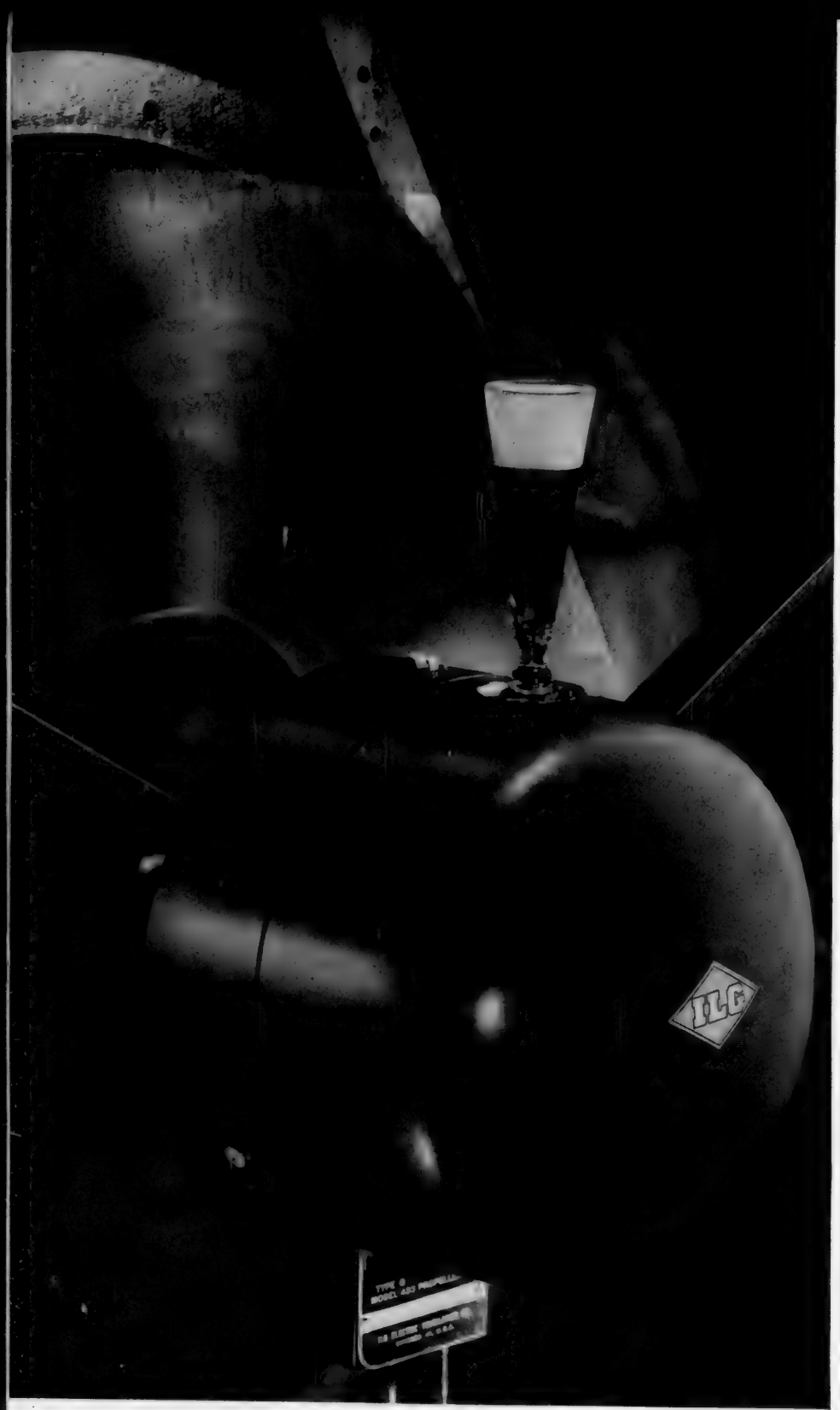
Here's the line voltage thermostat that has "everything" desired for accurately controlling temperature in motels, schools, offices and similar installations.

It has easy-to-read temperature and function selector dials. It has an accurate bimetallic thermometer with vertical dial. It has exclusive, locking type adjusting knobs, attached to cover but connected to adjusting shafts by factory-installed "keys" within the knobs. It has a unique, built-in but concealed adjustable high limit stop for temperature dial. It has an unusually sensitive element and mechanism which provide low operating differential at all voltages and all amperages within its rating. It has easiest "field wiring" ever... simply connect to large terminals *on back of thermostat.* And, it has modern "thin-line", compact styling. Learn more about this new thermostat... write to the Penn factory for Bulletin 3233.

PENN CONTROLS, INC. Goshen, Indiana

EXPORT DIVISION: 27 E. 38th ST., NEW YORK, N.Y.

AUTOMATIC CONTROLS FOR HEATING, REFRIGERATION, AIR CONDITIONING, APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES



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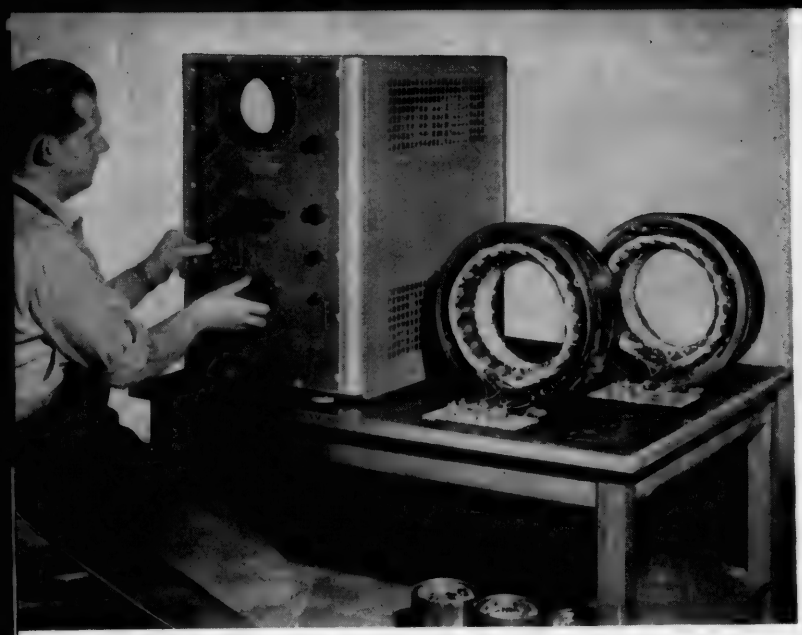
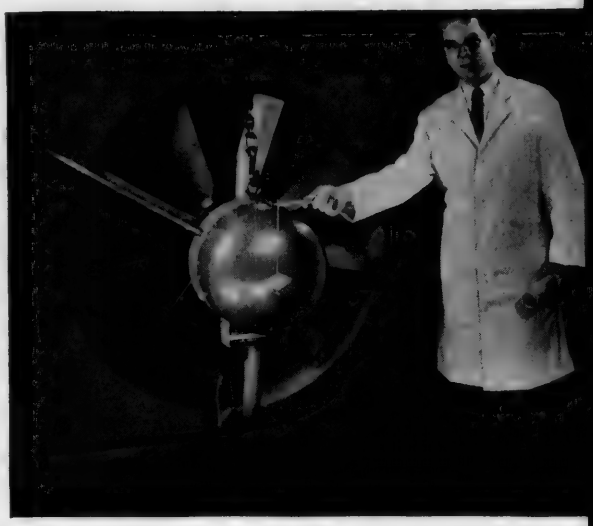
ILG®

BE RIGHT . . . WRITE IN



No Weak Windings. All windings in Ilg-built motor cores undergo turn-to-turn voltage torture tests to spot any winding insulation weakness. Moisture cannot affect cores since patented process assures uniform impregnation of motor windings.



New Propeller Fan Design. Ilg square panel propeller fans offer choice of three sizes (36-, 42- and 48-inch), two types of fan wheels (airfoil-design blades for higher static pressure or patented "Q" blades for super-silent operation). Motors are self-cooled, direct-connected.

Put a Pilsner on an Ilg propeller fan, as shown. Flip the starting switch. Now check the results with your own eyes.

Any bubbles in the beer? None. Here's why: Ilg direct-connected, self-cooled fans run so vibration-free it's like placing the Pilsner on a table.

You *eliminate* vibration, noise, maintenance when you ventilate with Ilg fans. Careful dynamic balancing of all component parts. . . and electronic checks of Ilg-built motors and patented Type "Q" fan wheels, *before* and *after* assembly . . . make certain that smooth, silent, maintenance-free operation is as much a part of each propeller fan as the Ilg "One-Name-Plate" pledge of performance.

For further information, write for Propeller Fan Catalog DB1-100.

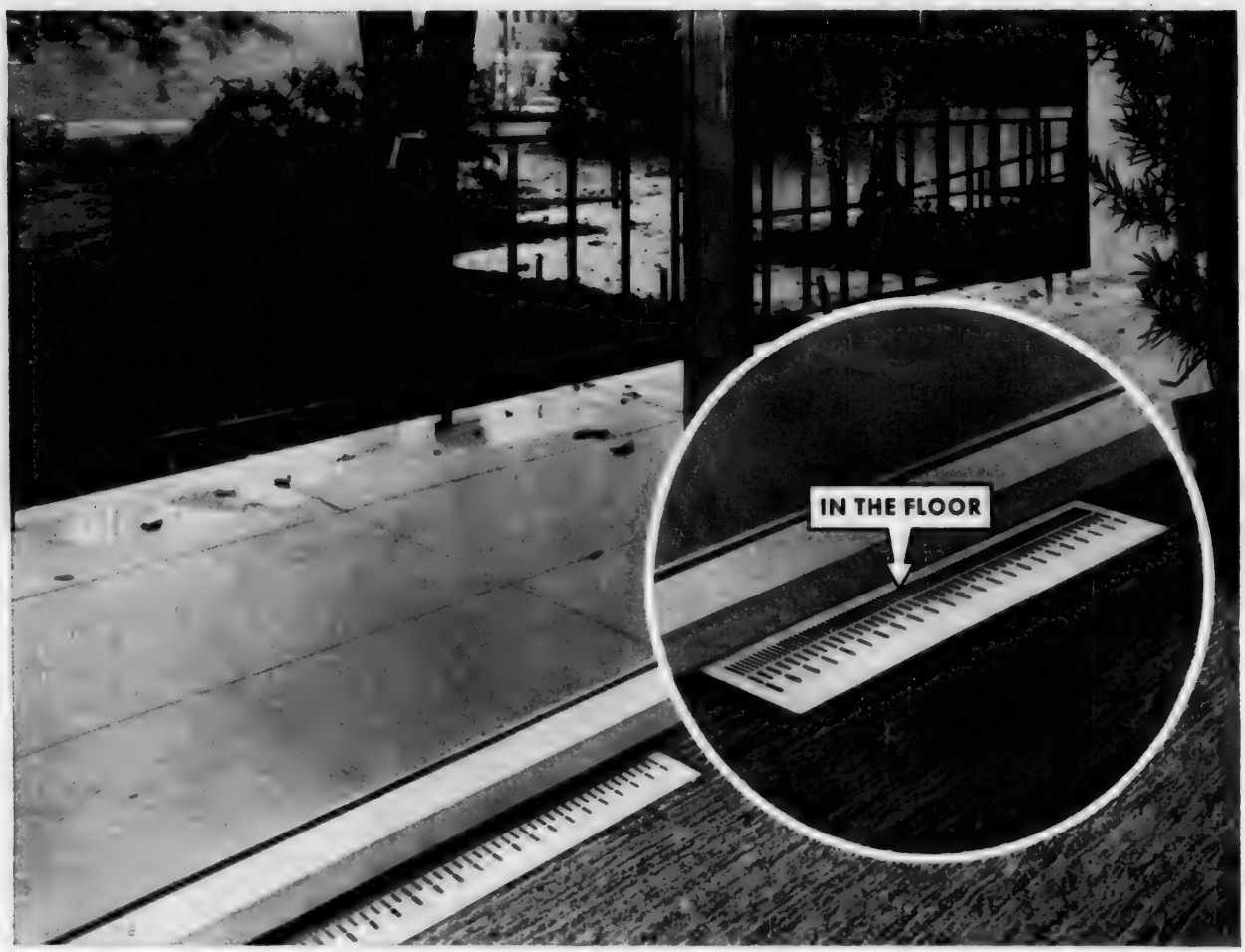
Follow the Flame for an easy-to-see demonstration of how vent pipe sucks in outside air to *pressure-cool* permanently lubricated Ilg-built motors. This famous Ilg self-cooling feature provides the protection of motor enclosure with the operating economy of an open motor. Ilg motors run cool, stay clean *inside and out.*

Pledge of Performance. This Ilg diamond trade-mark tells you that Ilg-built fan wheels, frames and motors combine modern design, careful craftsmanship, quality manufacture —your assurance of maintenance-free performance.

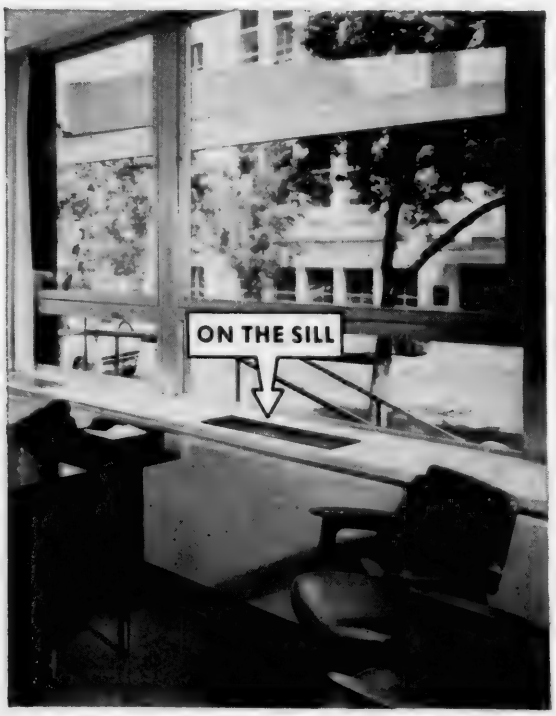
ILG ELECTRIC VENTILATING CO.

2851 No. Pulaski Road, Chicago 41, Ill.
Offices in 60 Principal Cities
Member of Air Moving and Conditioning Association, Inc. (AMCA)

Each Ilg product shown carries the rating seal of the Air Moving and Conditioning Association, Inc.



New Anemostat Stainless Steel Diffus-A-Plate



• withstands heavy traffic

• saves space

• provides excellent air diffusion

Anemostat Diffus-A-Plates for floor or sill application diffuse a pattern of conditioned air up the exterior wall and across the ceiling, insuring draftless comfort in the occupied zone.

Suitable for heating, ventilating and cooling. Induction type Diffus-A-Plates can be used as separate units or in continuous sections. Due to the design of the discharge openings which measure 1 inch by ¼ inch, these ruggedly constructed diffusers are heel and pencil proof.

Write for Anemostat Catalog DAP-70.

ANEMOSTAT.

ANEMOSTAT CORPORATION OF AMERICA

10 East 39th Street, New York 16, N. Y.

Representatives in Principal Cities

AC1374

For more data circle this page number on card at back of book

Ventilating Fans
...a galaxy of products to solve your air handling problems...
Industrial Fans
Propeller Unit Heaters
Centrifugal Unit Heaters
General Purpose Fans
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Sales offices: 3147 South Shields Avenue • Chicago 16

Our name is right on the pipe ...for your protection

Steel

For strength
... economy
... versatility

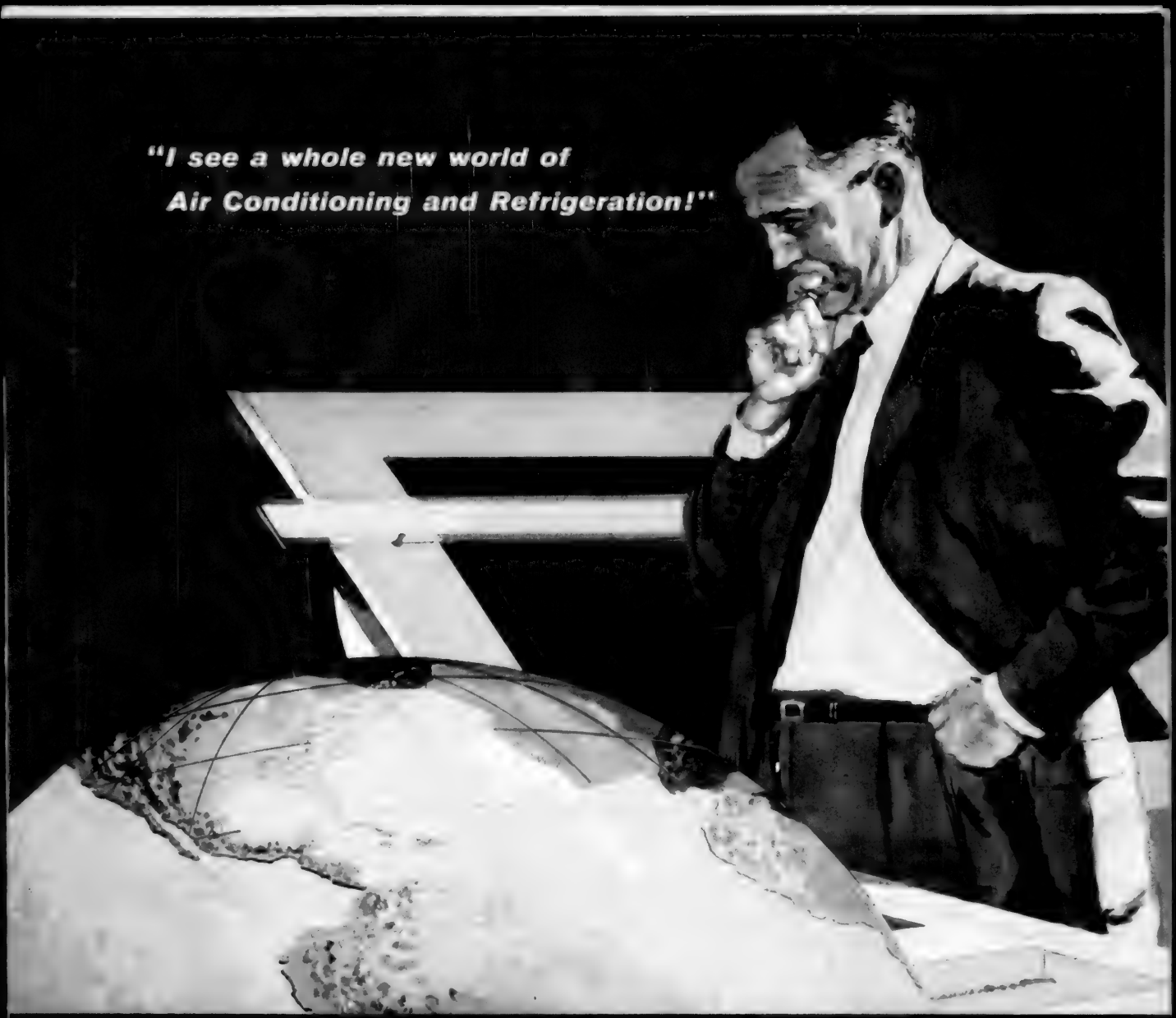
Every piece of Bethlehem continuous buttweld steel pipe now tells you it's Bethlehem pipe, and that it was made in the United States.

Know your pipe. Know your pipe distributor. And insist on steel pipe Made in U.S.A.

BETHLEHEM STEEL COMPANY, Bethlehem, Pa.
Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL



QUICK REFERENCE GUIDE

YORK CORPORATION
Subsidiary of Borg-Warner Corp.
YORK, PENNSYLVANIA

YORKAIRE 3-PIPE SYSTEM

Individual Heating or Cooling Instantly at Will

Automatic Year-Round Operation of Each Fan-Coil Unit in a Multi-Room Building

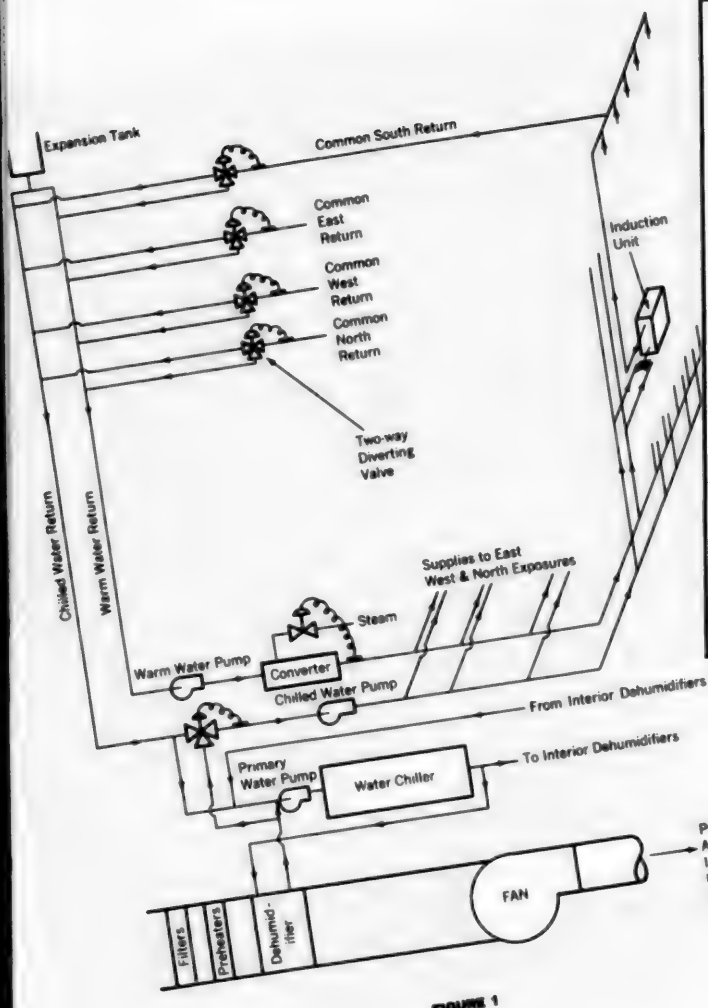
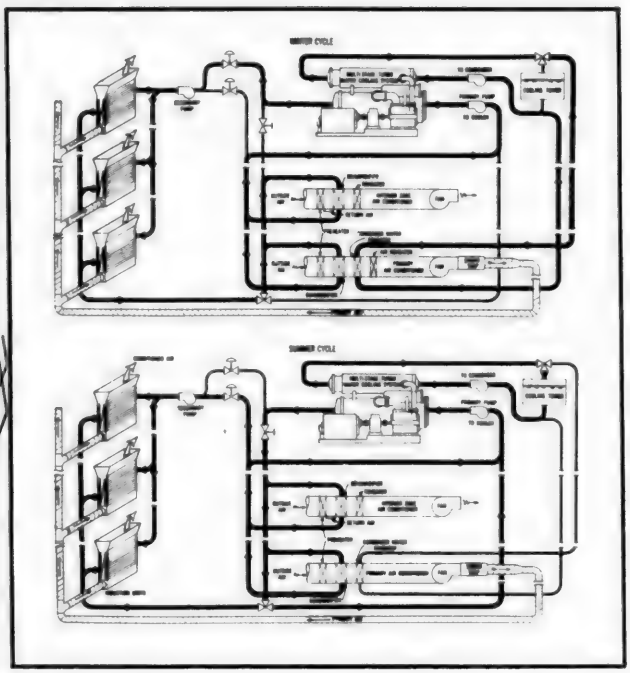
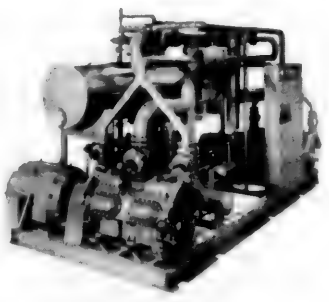


FIGURE 1





At left: Schematic diagram of Yorkaire 3-Pipe System with primary air supply.

Upper right: Schematic diagram of hot and chilled-water systems.

Lower right: View of York Heat Pump for Yorkaire 3-Pipe System.

Yorkaire 3-Pipe Systems provide unparalleled personal comfort. The occupant of each room in the building has a choice of either instant heating or cooling and ventilation when he dials his fan-coil or induction conditioner. The control valve modulates the flow of either hot water for heating or chilled water for cooling.

Costly reheaters and return air ducts are eliminated. Since primary air requirements are reduced, a considerably smaller equipment room is needed . . . freeing valuable space for other uses. Besides providing the ultimate in zoning, the entire system is unequalled for space-saving features.

YORK CONDITIONERS

Supply air for YORKAIRE 3-Pipe Systems, Conventional and Perimeter Installations

YORK HI-I

INDUCTION CONDITIONERS

York Hi-I Induction Units more than double the flow of conditioned air and sensible cooling capacity by providing High Induction of room air. This is especially important in the modern building where large glass areas and high intensity lighting create greater cooling requirements than were previously known.

With H-I induction units it becomes possible to safisfy these greater cooling requirements with a primary air system sized to meet only the minimum ventilation requirements. This reduces the equipment-space requirements throughout the building. Also, the Hi-I induction units are easily applied and installed either wall hung or floor supported. Both of these features reduce initial and installation costs below those required by conventional induction units.

YORK UNIVERSAL

FAN-COIL CONDITIONERS

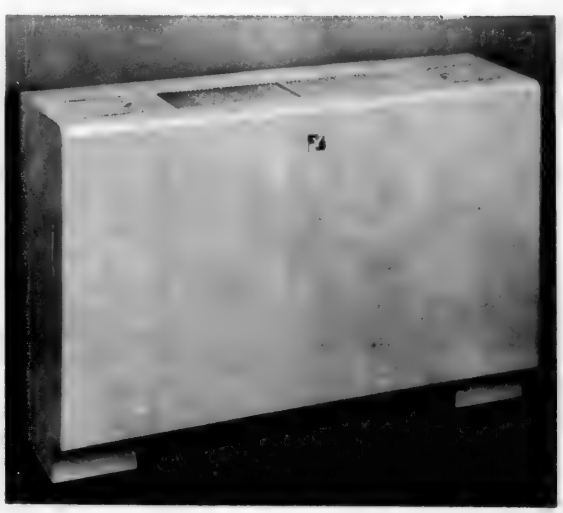
New in 1961—York's UNIVERSAL line of room fan-coil air conditioners provides a wide range of models for all applications. All models are designed for quick, low cost installation. For example, ceiling hangers permit one man installation of horizontal models.

Available in four basic model sizes—200, 300, 400, 600 cfm—all models are listed with Underwriters Laboratories.

- Floor Supported Basic Model
- Wall Supported Basic Model
- Ceiling Basic Model
- Ceiling Plenum Basic Model

Available in five decorative enclosure types finished in owner's choice of four baked enamel finishes to blend with any room decor.

- Floor Enclosure
- Semi-Recessed Enclosure
- Off-The-Floor Enclosure
- 19″ Sill Height Enclosure
- Ceiling Enclosure

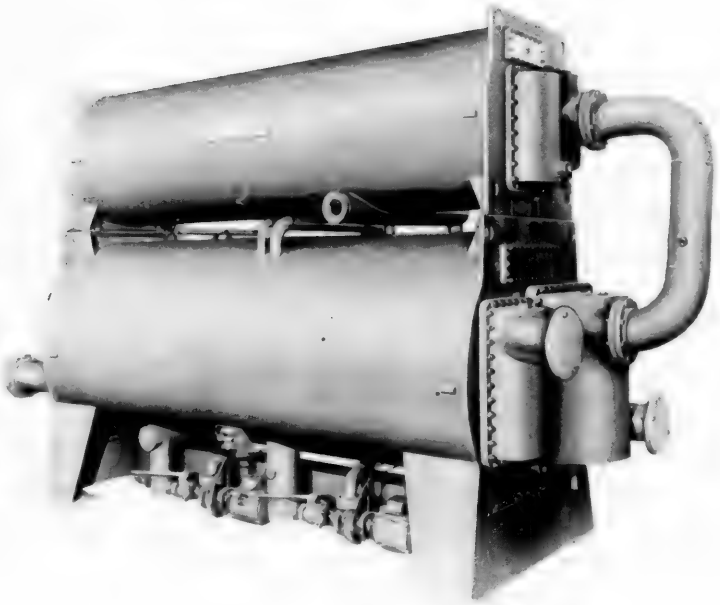


Let your York representative demonstrate to you how this wide application selection can save you money, both in system design and installation.

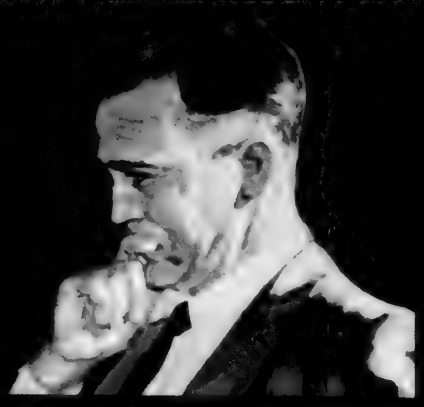
YORK WATER CHILLERS

YORK ABSORPTION SYSTEMS

York Absorption Systems provide chilled water for air conditioning and process refrigeration. Operation is economical, using hot water or low-pressure steam. Capacity can be varied economically according to demand, from overload to as little as 10% capacity. Operation is quiet; maintenance is simple—three small pumps with motors are the only moving parts. Capacities 50 to one thousand tons.

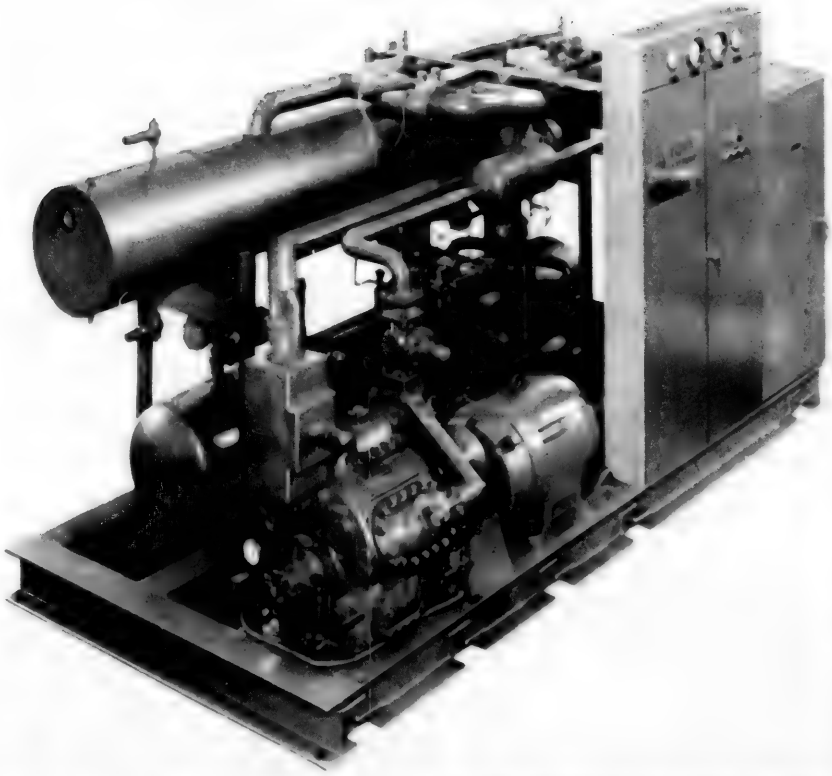


YORK TURBOPAK

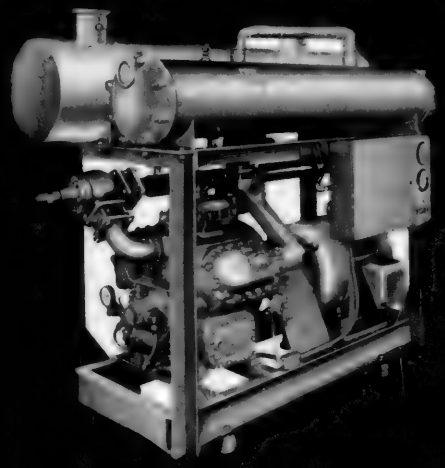


YORK
HEAT PUMPS

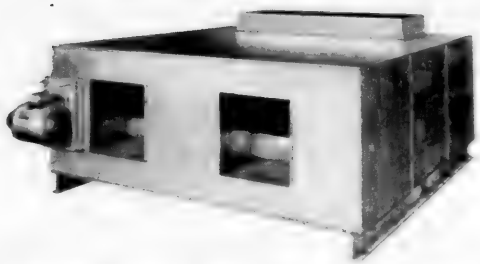
York Heat Pumps provide both hot and cold water for air conditioning. They can cool sunny rooms and "pump" the heat to warm the shady rooms, all thermostatically controlled. Using only outside air and incoming power lines, installations are practical in cold as well as warm climates since York's multi-stage compression extracts heat from sub-freezing air. Capacities are from 50 to 150 tons, and 280 to 1,230 MBH in factory packages or custom designed to meet other requirements. Turbomaster Centrifugal Compressors extend the range to 1700 tons and larger.



YORK
PACKAGED WATER
CHILLER

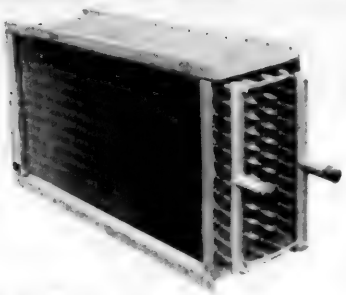


YORK CENTRAL STATION AIR CONDIT



YORK CENTRAL STATION AIR CONDITIONERS

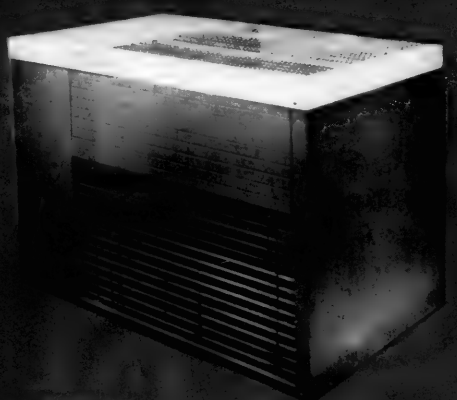
York Central Station Conditioners filter, cool, heat, humidify, dehumidify, and circulate air for comfort or process work. Horizontal, vertical, and multi-zone units. Capacities: 800 to 36,000 cfm.



YORK COILS York Hi-Eff Finned Cooling and Heating Coils feature high efficiency heat transfer and quality construction, designed for application ease . . . for chilled or hot water, brine, direct expansion refrigerants, standard and non-freeze steam.

YORK PACKAGED AIR CONDITIONERS utilize

comfort . . . by closely coordinating



YORK COMFORT CENTERS

York Comfort Centers provide residential and [illegible] heating. Electronic filters clean the air. Capacities: 2 to 5½ tons cooling, 60,000 to [illegible] Btuh heating.

YORK CHAMPIONS

York Champion Air Conditioners and Air-Cooled Condensing Units have up to three compressors and three fans in step sequence. Dual coils sub-cool the refrigerant. Makes possible comfort cooling even when it's zero outdoors. Available in models for ceiling suspension. Capacities: 5 to 25½ tons.

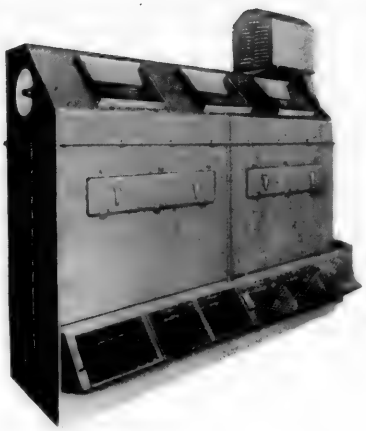
YORK EMBASSY UNITS

York Embassy Air Conditioners, ducts optional, provide residential or commercial cooling, which varies with load for economy. Capacities: Packaged [illegible] systems—3 to 25 tons cooling, [illegible],000 Btuh heating.

IONING and CONDENSING UNITS

YORK ECONOMIZERS

York Economizers (evaporative condensers) combine the advantages of a water-cooled condenser and cooling tower usually at less cost, less space, less weight. Install indoors or out. Sectionalized. Capacities: 5 to 150 tons.

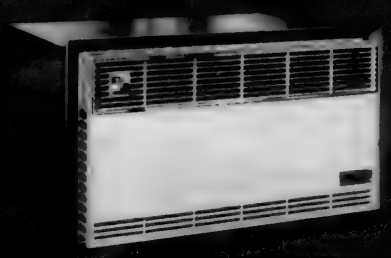


"Balanced Cooling" for complete all phases of system

YORK PATHFINDERS

YORK TWINLINES

YORK ROOM AIR CONDITIONERS



Wherever you go... THOSE WHO DEMAND THE FINEST IN AIR CONDITIONING AND REFRIGERATION CHOOSE YORK

Air Conditioning

Allen Manufacturing Co.
Bloomfield, Conn.

Birch Towers
Ft. Lauderdale, Fla.

Carson, Pirie, Scott & Co.
Chicago, Ill.

Conrad Hilton Hotel
Chicago, Ill.

Flick-Reedy Corporation
Bensenville, Ill.

Foley's
Houston, Texas

Fulton National Bank
Atlanta, Ga.

Illinois Power Co.
Decatur, Ill.

Insurance Company of North America
Richmond, Ind.

Maryvale Shopping Center
Phoenix, Ariz.

Mile High Center
Denver, Colo.

Nationwide Inn
Columbus, Ohio

Statler-Hilton Hotel
Boston, Mass.

Sylvania Electric Products Co.
Amherst, N. Y.

3 Penn Center Plaza
Philadelphia, Pa.

300 Park Avenue
New York City

Refrigeration

Greensboro Ice Cream Co.
Greensboro, Md.

John Morrell Co.
Sioux Falls, S. D.

Pacific Fruit Express Co.
Ogden, Utah

Shell Oil Co.
Deer Park, Texas

Sinclair Refining Co.
Wellsville, N. Y.

Wissahickon Skating Club
Philadelphia, Pa.

Wyandotte Chemicals Co.
Geismar, La.

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Columbus 24, 1273 Carbone Drive

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TEXAS
Dallas 2, 1707 Cedar Springs Road
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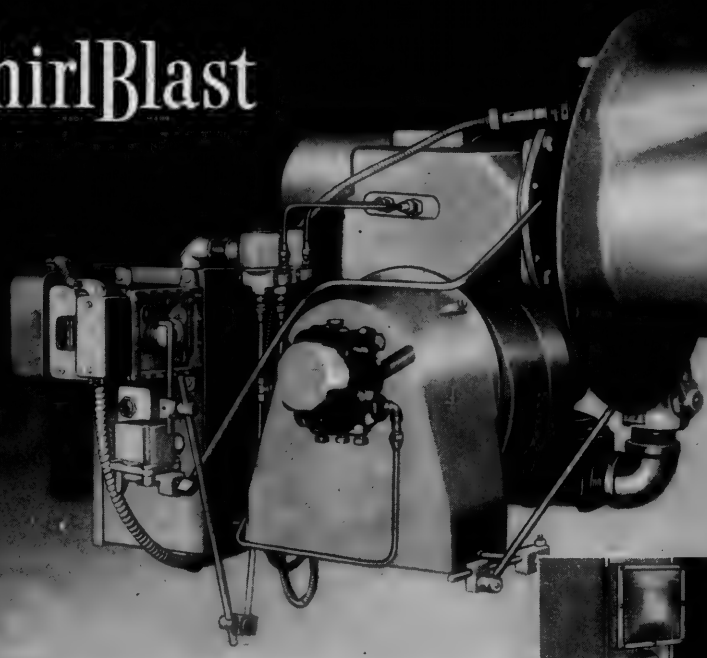
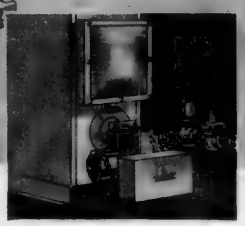
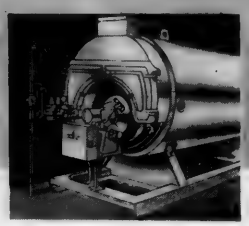
A new development by Iron Fireman

WhirlBlast



DUAL FUEL FORCED DRAFT BURNER





Makes firebox boilers super-efficient

NO SMOKE

Burns clean in less than 10 seconds. The WhirlBlast flame is brilliantly clean almost instantly, and stays clean. Although accepted standards of oil firing allow a 15 minute warm-up period, during which time smoke is tolerated, the Iron Fireman WhirlBlast burner is clean in seconds. Smoke and soot are unburned fuel—completely wasted by smoky starts.

NO STACK

Needs only an exhaust vent. Boilers with conventional burners require from 30 to 80 feet of stack or an induced draft fan. Sealed steel firebox boilers with WhirlBlast burners require only a small exhaust vent.

CONSERVES BOILER HEAT

Standby loss is almost nil. The highly efficient WhirlBlast burner does not need a refractory combustion chamber to "support combustion." Consequently there is no brickwork to store heat to be wasted during "off" periods. Standby heat loss is reduced to an insignificant minimum.

CUTS COSTS

Low fuel bills; low maintenance. Efficient combustion and low standby loss conserve fuel. Elimination of smoke and soot means no fouled boiler tubes, no carboned nozzles or electrodes; no refractory maintenance expense.

A COMPLETE PACKAGE

No special skill to install, adjust, service or operate. The WhirlBlast burner (for gas, oil or dual-fuel combination) comes from the factory fully wired and tested. Bolts to boiler front with firing head through fire door. No special combustion chamber or firing pit needed. Exceptional installation saving.

Send coupon for further information.

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AUTOMATIC FIRING EQUIPMENT
FOR HEATING, POWER, PROCESSING

IRON FIREMAN MANUFACTURING COMPANY
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Please send me more information and specifications on the Iron Fireman WhirlBlast burner.

Name .....
Firm .....
Address .....
City ..... Zone ..... State .....

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SPECIFY *90% reduction in sound power!*

SPECIFY *efficient whisper-quiet ventilation!**

SPECIFY *prefabricated thermo-insulated curb with built-in cant strip!*

get all three SPECIFY...

JENN-AIR Q T SOUND CONTROL CURB

**Only 10% reduction in air moving capacity*

PATENT PENDING

JENN-AIR

Eliminates Field Constructed Curb Costs

for facts, figures and specifying data write for Bulletin 601-SC

JENN-AIR PRODUCTS COMPANY, INC. 1102 Stadium Drive · INDIANAPOLIS 7, INDIANA

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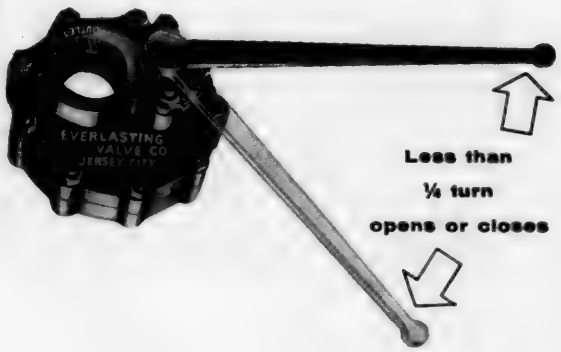
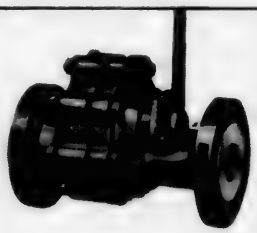
WHEN YOU NEED.....

- Quick Action
- Leak-Proof Seal
- Minimum Pressure Drop
- Straight-through full flow
- Valves that cannot wedge or jam
- Self-grinding rotating disc

SPECIFY EVERLASTING VALVES

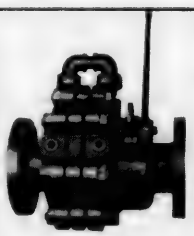


BOILER BLOW-OFF
Quick acting, also handwheel operated "Y" and angle types. For pressures up to 600 psi.



GENERAL SERVICE
Where drop-tight seal and full flow is essential.

CYLINDER OPERATED
Can be remotely controlled, electrically or manually.



STEAM JACKETED
Assures free flow of viscous materials.

WEIGHT-OPERATED
For automatic drains or emergency shut off.

For more information write for these bulletins →

Everlasting VALVES

EVERLASTING VALVE CO., 75 FISK STREET, JERSEY CITY 5, N. J.

EV-407

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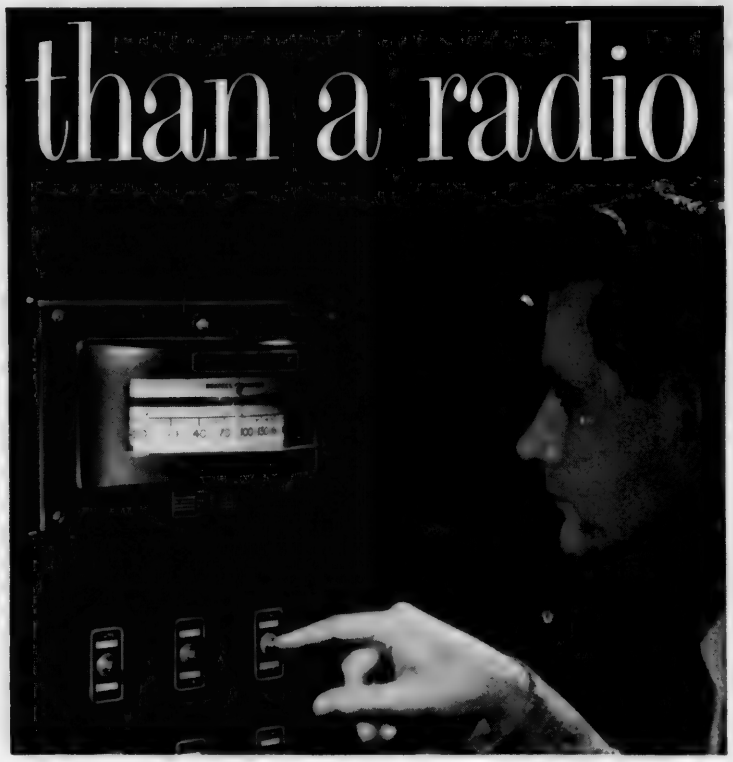
ELECTRONIC control .

See our exhibit
Booth No. 506-508
International Heating &
Air Conditioning Exposition
Chicago, Feb. 13-16

. . simpler than a radio



More reliable than an elevator

Everywhere you turn, reliable electric and electronic components and systems work for you. You hardly think about them — your radio, an elevator, your dictating machine, the generator cutoff in your automobile.

Barber-Colman *Electrionic* control for heating, ventilating, and air conditioning provides even more dependable service than the items listed above. It combines electric and electronic components to give you fast, accurate sensing and adjustment of temperatures and air flow. You don't have to convert electrical energy into mechanical energy in an *Electrionic* control system — it makes direct use of the electrical power that's available in every building.

Simpler than a radio, it's easy to service. More reliable than an elevator, it seldom needs attention. It is instantaneously responsive and extremely accurate. For large or small installations, *Electrionic* control often costs less in the first place, and always costs less in the long run.

You don't have to be an electric or electronic engineer to understand *Electrionic* control. You will feel right at home with it after you've read Barber-Colman's new *Electrionic* Handbook which graphically explains the principles in a very readable way. You're welcome to a copy. Just call your local Barber-Colman automatic controls office or write:

to operate transistorized motor operators for accurate control of air and liquid flow.

BARBER COLMAN

BARBER-COLMAN COMPANY

Dept. N 1302 Rock Street, Rockford, Illinois

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MARSH PACKLESS RADIATOR VALVES

WHEEL HANDLE

GRADUATED

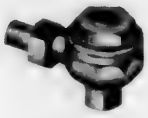
LOCK AND SHIELD

ANGLE PATTERN

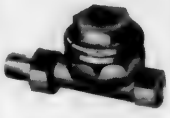
GLOBE PATTERN

CORNER PATTERN (Sectional Below)

MARSH THERMOSTATIC RADIATOR TRAPS



ANGLE PATTERN

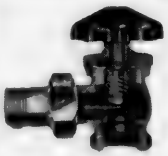


STRAIGHTWAY PATTERN

VERTICAL PATTERN

LEFT HAND CORNER PATTERN

RIGHT HAND CORNER PATTERN



CUT OPEN VALVE

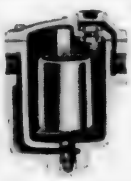
F&T TRAPS

No. 12, REPRESENTATIVE OF WIDE LINE

VENTS

No. 5 VENT, ONE OF MANY

BUCKET TRAPS

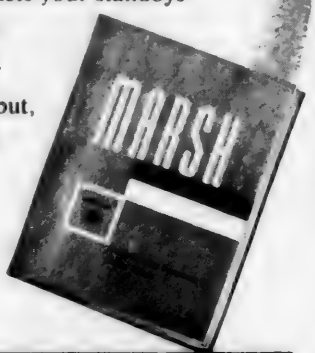


No. 500 INVERTED BUCKET TRAP

All the best of their kind!

You probably have made certain Marsh products your standbys without realizing there are a lot more of them just as superlative as the ones you like so well.

Make the acquaintance of some of them here, but, better still—***Ask for this Marsh Catalog!***



Marsh Instrument Company
Division of Colorado Oil and Gas Corporation
Dept. U, Skokie, Ill.
Marsh Instrument & Valve Co. (Canada) Ltd.
8407 103rd Street, Edmonton, Alberta

MARSH
Heating Specialties since 1865

GAUGES AND THERMOMETERS

THER-ALTI-METER (Square and Round)

HOT WATER BOILER THERMOMETER

PIPING THERMOMETER
Four Ranges
(Also remote reading)

DUCT THERMOMETER
Three Ranges
(Also remote reading)

For more data circle this page number on card at back of book

try this on your pipe...

(it's Pittsburgh Fiber Glass Pipe Insulation)

Acme Insulation Company, Pittsburgh, did . . . on the piping job at Pittsburgh's new Gateway Parking Garage in Gateway Center. And here's what Acme owner Walter S. Peebles says about this installation:

"We chose Pittsburgh Fiber Glass Insulation for its efficiency, appearance and permanence. It's lightweight, handles easily, cuts readily with a knife, is quickly applied. There's a minimum of waste material.

"We've found that Pittsburgh Pipe Insulation holds its size and shape, does not effect the metal it covers, and has a fine record for low-cost maintenance. We used 8,300 ft of it on ½" to 14" pipe for underground heating, snow melting, chilled water lines, general plumbing, sill cocks and drain lines.

"It's probably the finest insulation that can be used, especially in subsurface locations."

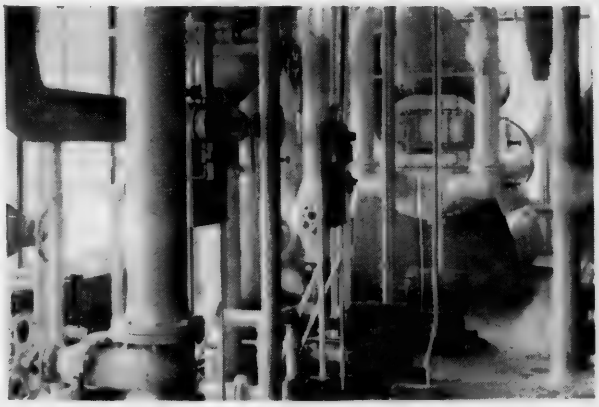
FOR TOP THERMAL CONTROL, THIS IS IT! Pittsburgh Fiber Glass Pipe Insulation is a molded flexible hollow cylinder, slit along its length to provide quick application to pipes or tubing. It has high thermal efficiency for any type pipe insulating job and is surprisingly economical. You can get complete details from your nearest PPG Fiber Glass Sales Office, or by writing to *Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Penna.*

SALES OFFICES: Atlanta, Attleboro, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Fort Wayne, Houston, Kansas City, Los Angeles, Louisville, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco and Washington.

FIBER PPG GLASS PITTSBURGH PLATE GLASS COMPANY

This new 3101 Euclid Avenue Building in Cleveland meets every modern requirement in the book. Attractive exterior, with glass and aluminum curtain walls. Most comfortable interior, with air conditioning by Gas-operated Carrier Absorption Refrigeration.

Attracts tenants with comfort cooling by GAS-operated CARRIER Absorption Refrigeration



AIR CONDITIONING PENTHOUSE. This equipment in penthouse atop the building includes two gas-fired Bryant boilers, 300-ton capacity Carrier Absorption unit to chill water for the Carrier Weathermaster air conditioning system, and Carrier cooling towers, too. Roof-top installation frees basement area for other uses.

H. L. Vokes Company of Cleveland, designers and builders of the new 3101 Euclid Avenue Building in that city, are experts in two-way satisfaction. They satisfied their tenants and their own cost requirements with one of the most efficient types of modern air conditioning– Gas-operated Carrier Absorption Refrigeration.

Comfort cooling in this building starts at the same two gas-fired boilers that furnish heat in winter. The Carrier absorption unit uses low pressure steam from the boilers as the energy source for water chilling. Thus, no prime mover is needed. Boiler capacity is put to use on a year 'round basis. And thrifty gas keeps fuel costs low.

Judge for yourself the efficiency and economy of Gas-operated Carrier Absorption Refrigeration. Specific performance data and cost details are yours for the asking. Just call your local gas company, or write to Carrier Corporation, Syracuse 1, New York. AMERICAN GAS ASSOCIATION.

FOR HEATING & COOLING GAS IS GOOD BUSINESS

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Mr. Paul E. Grunau, center, talking over an installation problem with Mr. Morton R. Spence, left, of Rundle-Spence, National Tube Distributor, and Mr. Leslie Smith, National Tube's representative in Milwaukee. This type of round-table discussion indicates the close relationship between contractor, National Tube Distributor and National Tube.

"We had only 14 hours to repair a cooling system and save $100,000 in perishable foods—

our National Tube Distributor helped us finish the job in 12 hours,"

says Mr. Paul E. Grunau, Secretary-Treasurer, Paul J. Grunau Company, Mechanical Contractors, Milwaukee, Wisconsin

"We got this emergency job late at night," says Mr. Grunau. "Yet, our National Tube Distributor, the Rundle-Spence Company, gave us immediate service. But our National Tube Distributor is always ready for critical situations. He keeps two trucks on a stand-by basis, and there's a four-man crew on 15-minute call seven days a week.

"Rundle-Spence offers expert engineering and technical advice, constantly feeds us new product information, and is a single, complete source of steel tubular products. We also know that our National Tube Distributor has a wide range of available pipe sizes—⅛-inch to 24-inches. We've standardized on National Tube products for all piping installations, because they're the finest tubular products in the world."

Why don't you combine the fast, dependable service and technical assistance of a National Tube Distributor with USS National Steel Pipe? The next time you need top-quality steel pipe for plumbing, heating, power or air-conditioning applications, see your local National Tube Distributor.

USS and National are registered trademarks

National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York

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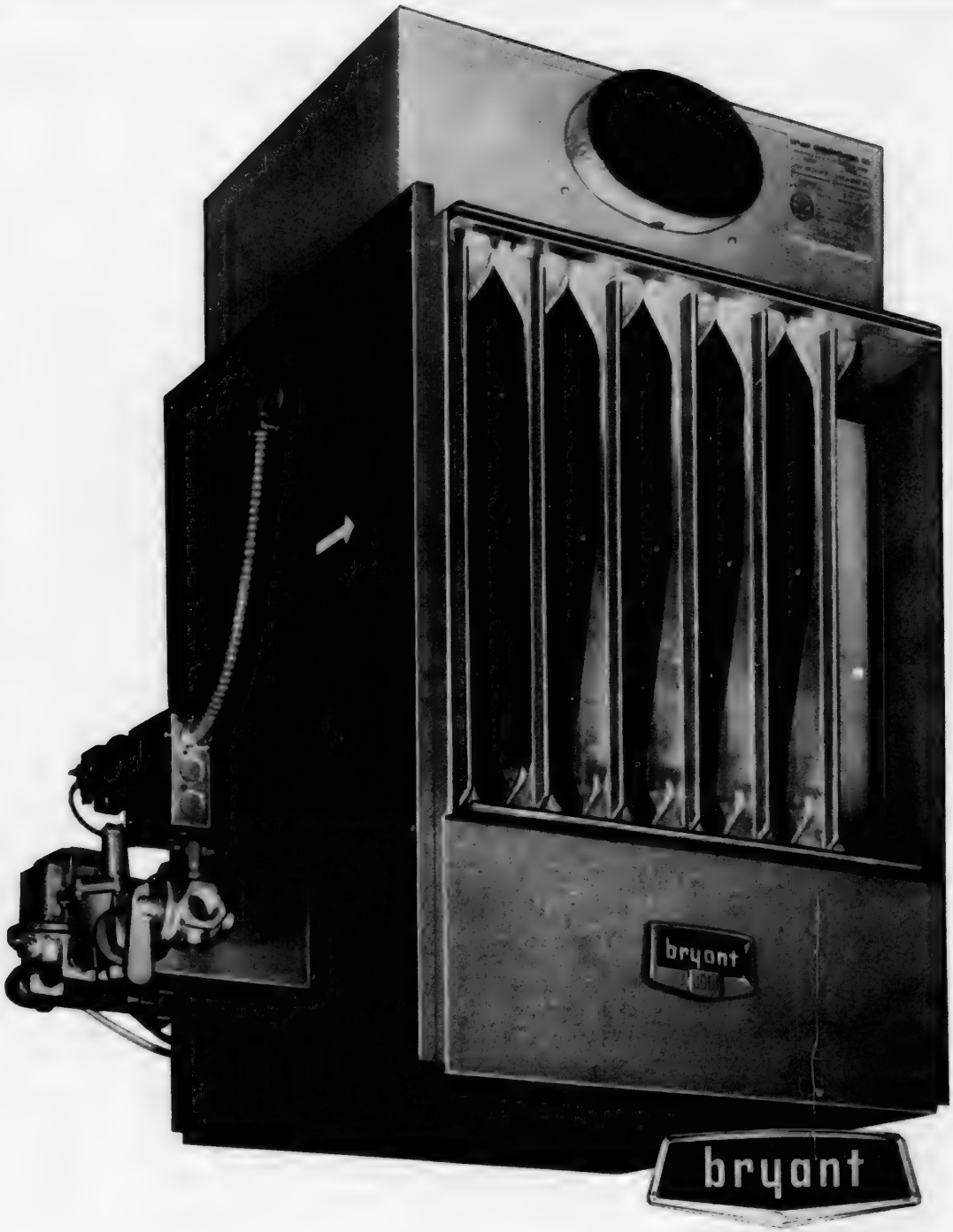

DUCT HEATERS

NEW
FROM BRYANT
GAS-FIRED DUCT HEATER LINE

COMPLETE RANGE OF CAPACITIES. 8 sizes—50,000 to 250,000 Btu/hr. By twinning the units you can get capacities up to 500,000 Btu/hr. **FULL LINE OF BLOWER PACKAGES.** Open and closed types suitable for heating and air conditioning. **CONTROLS.** Exclusive valve and pilot can be mounted on either side. **SLIP JOINT DUCT CONNECTIONS** and guide holes in flanges speed up fastening. **SERVICE IT FROM REAR.** No more bottom servicing. **TRI-ALLOY HEAT EXCHANGER.** Provides faster heat transfer, minimizes noise and resistance to air flow. Three-way protection against high temperatures, corrosion and condensation. **DRAFT HOOD** can be reversed to facilitate flue connection. For complete product information call your local Bryant Distributor or Factory Branch, or write Bryant Manufacturing Co., Indianapolis, Indiana.

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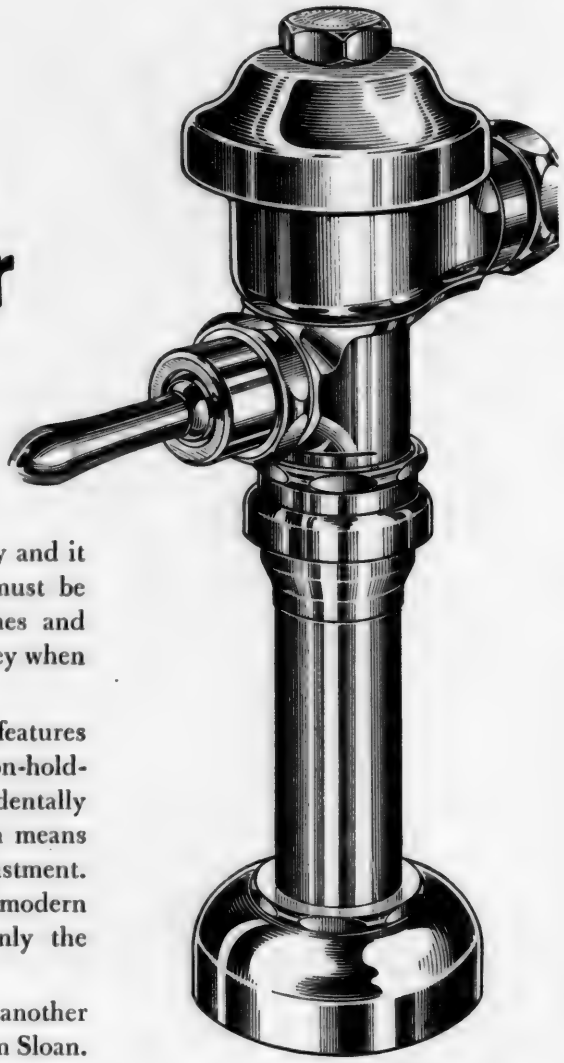
You pay no more for unequalled SLOAN quality...

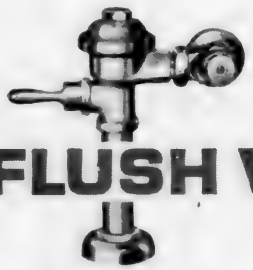
Sloan Flush Valves Save Water



• Water is scarce in many parts of the country and it costs money—and costs often rise when it must be pumped within a building to distant branches and upper floors. You can save both water and money when you specify the Sloan ROYAL Flush Valve.

In the ROYAL, there are two water-saving features providing maximum water economy—(1) "non-hold-open," which prevents the waste of water accidentally or maliciously and (2) "no regulation," which means there is no regulating screw to get out of adjustment. These are the two most important features of modern flush valves and, as standard equipment, only the ROYAL has both.

This exclusive combination of features is another example of that bonus of quality you expect from Sloan. And since you can have Sloan quality at no extra cost—why not make sure you get it.



SLOAN FLUSH VALVES

SLOAN VALVE COMPANY • 4300 WEST LAKE STREET • CHICAGO 24, ILLINOIS

For more data circle this page number on card at back of book

A MOST SIGNIFICANT BREAK-THRU IN THE HISTORY OF AIR CONDITIONING

Soon you can have it! HI-PRESS AIR CONDITIONING OF AMERICA, INC., pioneer developer of small-pipe high-velocity air systems used in over 500 ships the world over, is fast readying this revolutionary concept for adaptation to a multitude of industrial/commercial applications on Land. (Pssst . . . listen! This small, twin-pipe system requires half the space needed for conventional ductwork, special pipe and fittings are Aerodynamically designed, noise attenuating, special clamping device gives leakless construction.)

A MOST IMPORTANT NEW TEAM IN ALL THE INDUSTRY

On December 15, 1960, the big news broke . . about our spirited new combo: HI-PRESS and DRAYER-HANSON, who then became a Division of Hi-Press. This most logical welding of two key names constitutes a 500% growth factor. It means limitless facilities, talent, "know-how" are high-gearing to give you all the excitement noted above, plus a bold, broad line-up of air conditioning and refrigeration products to thoroughly "pace-set the Sixties." D-H—since 1910 a leading designer/manufacturer of quality air conditioning and refrigeration! HI-PRESS—the big name in Marine air conditioning. Watch us GO!

drayer-hanson
DIVISION OF
HI-PRESS AIR CONDITIONING OF AMERICA, INC.*

THE MOST URGENT THING FOR YOU TO DO RIGHT NOW . . .

If you are: (1) "itching" for details, (2) have even a remote interest—Get to Chicago, February 13th through 16th! Or, keep your eye on The 15th International Heating & Air Conditioning Exposition. We'll "peek-preview" these exciting developments—Booth #1172—under the proud new banner of HI-PRESS AIR CONDITIONING OF AMERICA and DRAYER-HANSON DIVISION, HI-PRESS. Meanwhile, call a Drayer-Hanson sales agent near you or receive the Full Facts on our products by contacting us now.

*Administrative Offices: Los Angeles—3301 Medford Street • New York City—Chrysler Building, 405 Lexington Avenue Main Plant: 3301 Medford Street, Los Angeles 63, California

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106-Acre

BERGEN MALL

Shopping Center

One of world's largest. Has central heating plant; incinerator operation generating part of steam . . . 13 individual cooling towers . . . air-curtains to avoid doors in main buildings . . . 8,600 car parking.

Owner — ALSTORES REALTY CORP.

Architects-Engineers — JOHN GRAHAM AND COMPANY, NEW YORK & SEATTLE

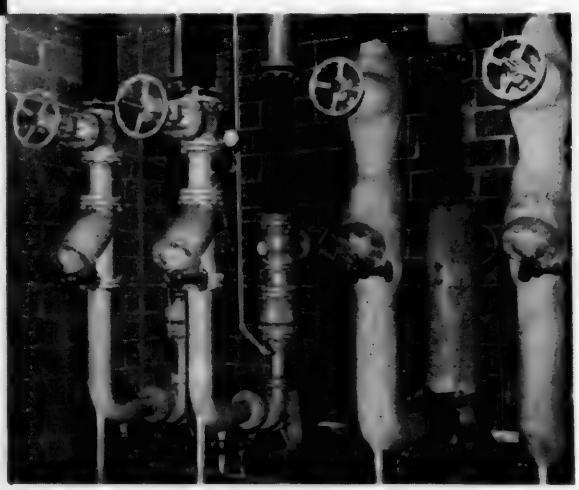
Mechanical Contractor — FRANK A. MCBRIDE CO., PATERSON, N. J.

Low-cost, trouble-free control of the complex piping system obtained with JENKINS VALVES

250,000 people a week come to this huge Northern New Jersey shopping center to satisfy most of life's needs other than sleep. Its shops, banks, offices, theaters, restaurants and varied personal services occupy 920,000 square feet of buildings.

The plumbing, heating, air conditioning, fire protection and sanitation facilities of this city-like project are as hard-working as they are complex. Valves with extra-stamina were needed for control of the piping system. Every possible protection against troubles and the high costs of valve maintenance and replacement was demanded. It was obtained with the specification so often written for tough, critical jobs . . . *"valves to be* JENKINS".

Especially since they cost no more, it is surely worthwhile to insist on Jenkins Valves for your valve jobs. Jenkins Bros., 100 Park Avenue, New York 17.



Valves on air conditioning system pumps.

JENKINS

VALVES

JENKINS SINCE 1864 Jenkins Bros

SOLD THROUGH LEADING DISTRIBUTORS EVERYWHERE

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A MAJOR BREAKTHROUGH IN COOLING & HEATING

ARKLA'S NEW 25-TON GAS CHILLER-HEATER

Here it is—the revolutionary new Arkla absorption unit that heats and cools without a steam producing boiler or converter. Gas-fired burners in the generator section energize the system for absorption cooling, or for heating. It's the perfect system for modern year 'round gas air conditioning.

INSTANTLY HEATS AND COOLS AUTOMATICALLY ■ HEATS WATER WITHOUT A BOILER ■ COOLS WATER WITHOUT A COMPRESSOR ■ REQUIRES NO LUBRICATION ■ SEALED FOR LIFE, REQUIRING MINIMUM MAINTENANCE ■ MAINTAINS SAME CAPACITY FOR THE LIFE OF THE UNIT ■ HAS NO MOVING PARTS IN THE HEATING AND COOLING CYCLE ■ FIRST MEDIUM OR LARGE TONNAGE AIR CONDITIONER THAT HEATS. Truly revolutionary . . . investigate for your next building project the new Arkla DF-3000 Gas-fired All Year® Chiller-Heater.

FOR DETAILS CONTACT YOUR LOCAL GAS COMPANY
OR WRITE ARKLA AIR CONDITIONING CORPORATION
812 MAIN STREET • LITTLE ROCK, ARKANSAS

ARKLA-Servel

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send for bulletin no. 4

easier to maintain ... easier to install ...

Striking new economies are now available for commercial, industrial and institutional buildings with P-K's SCALEFREE 230, the first indirect gas fired storage water heater • **Installation.** A complete and automatic package, P-K's SCALEFREE 230 can be skidded into place, hooked up and checked out quickly. There is no complicated piping or electrical work to run up costs. No stack is needed for extra draft. No foundation is necessary. Factory insulation (optional, as illustrated) further reduces costs and avoids the complications of on-the-site insulating. • **Maintenance.** P-K's SCALEFREE 230 offers new freedom from trouble. It won't scale—and retains its rated efficiency—because heat transfer occurs below the temperature at which scaling minerals precipitate. Linings of Pre-Krete® or copper keep the storage section free of rust and corrosion regardless of water conditions. • P-K's SCALEFREE 230 is available in storage capacities from 250 to 4,000 gallons; recovery sections from 390,000 to 2,215,000 BTU. Bulletin No. 4 gives complete engineering and performance data.

Address your request to: The Patterson Kelley Co., Inc., 22 Morgan Avenue, East Stroudsburg, Pennsylvania.

Patterson Kelley
Water Heater Division

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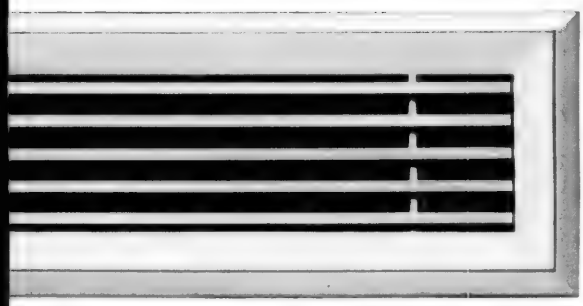
Tuttle & Bailey Air Distribution Equipment

IMPERIALINE EXTRUDED ALUMINUM GRILLES



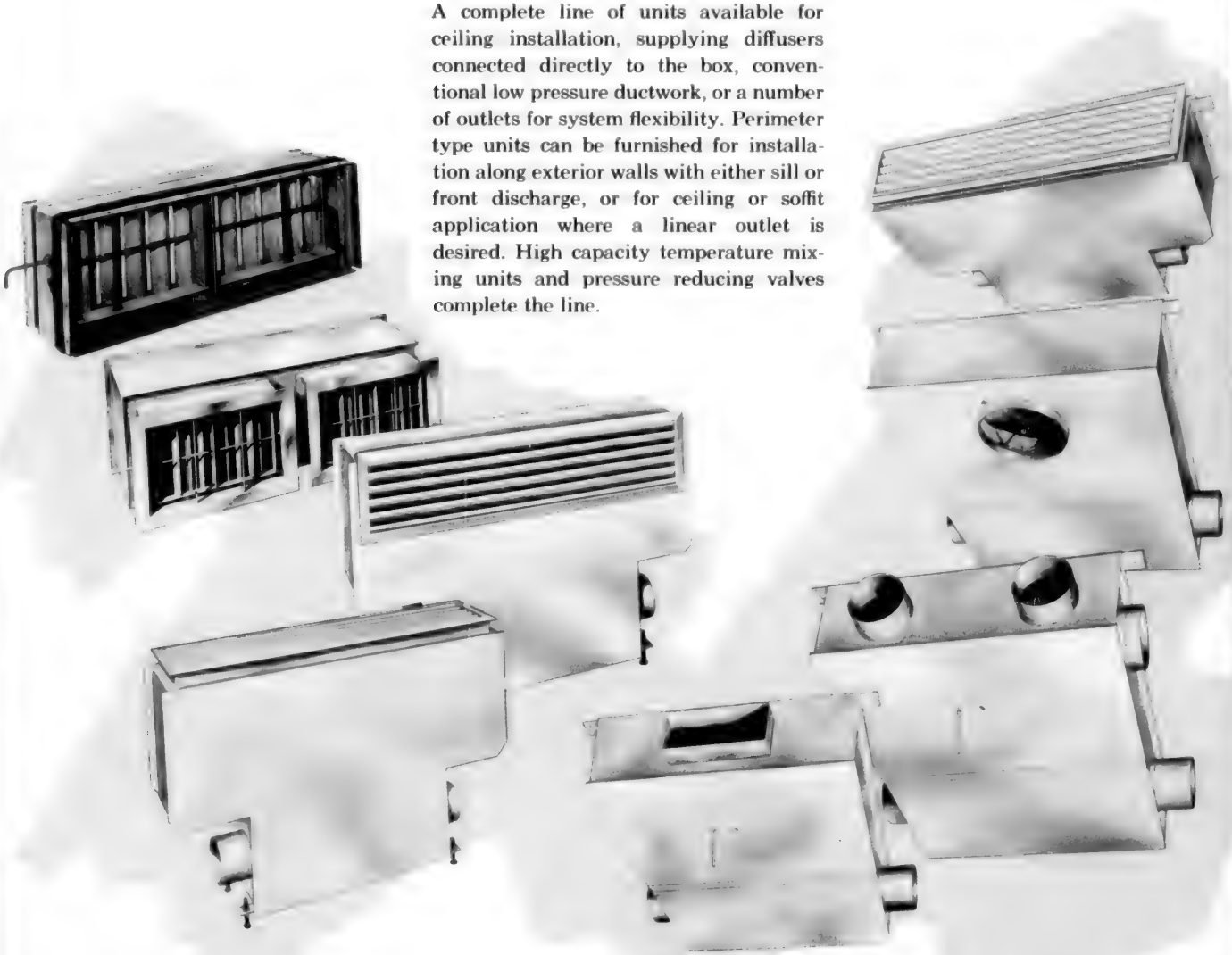
Designed to harmonize with or accent linear design concepts . . . may be used for supply or return on heating, cooling, or ventilating systems . . . ideal for ceiling, sidewall, floor, or sill installation.

Six margin styles. Can be furnished in one-piece construction up to 72″ x 48″ where the 72″ dimension can be either length or height . . . available in listed sizes of 1½″, 2″, 2½″, 3″, 4″, 5″ and in 2″ increments from 6″ through 72″.

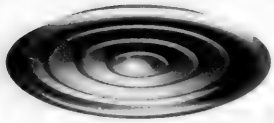
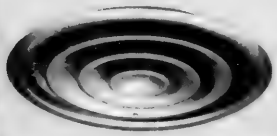
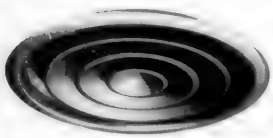
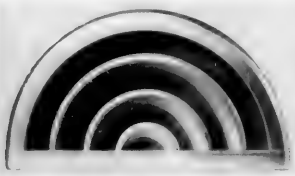
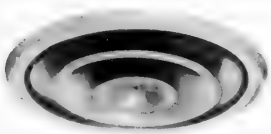
Bars can be furnished set straight, deflected 15° or 30°. A pencil-proof is also available.

HIGH PRESSURE EQUIPMENT

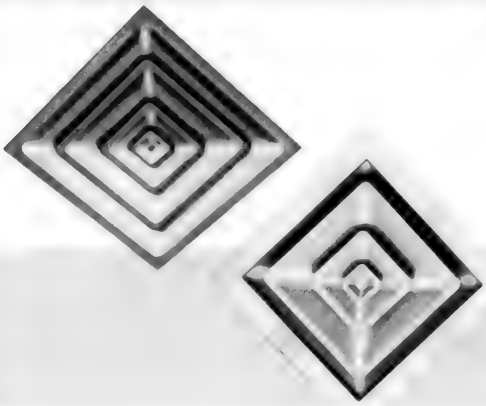
A complete line of units available for ceiling installation, supplying diffusers connected directly to the box, conventional low pressure ductwork, or a number of outlets for system flexibility. Perimeter type units can be furnished for installation along exterior walls with either sill or front discharge, or for ceiling or soffit application where a linear outlet is desired. High capacity temperature mixing units and pressure reducing valves complete the line.



Ceiling Diffusers – Round

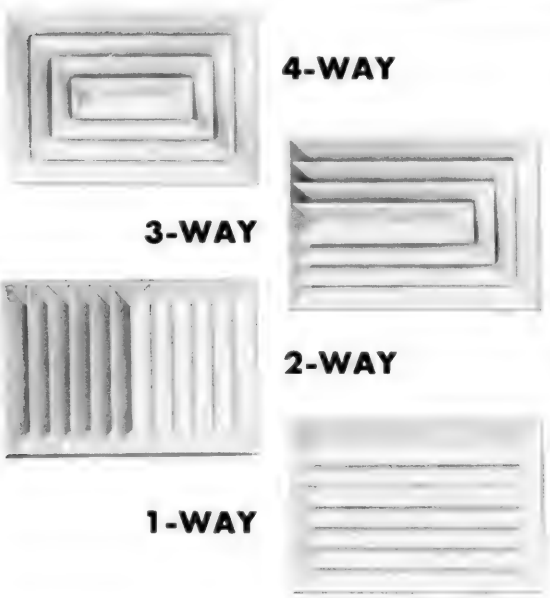
TYPE	CROSS-SECTION	DESCRIPTION	APPLICATION	LISTED SIZES
 **PA**		Adjustable Pattern (Full)	Ceiling or Exposed Duct	6-8-10-12-14-16-18-20-24-30-36
 **PS**		Stepped Down, Fixed Pattern	Ceiling or Exposed Duct	6-8-10-12-14-16-18-20-24-30-36
 **PF**		Flush, Fixed Pattern (also available with light fixture Type PLF)	Ceiling	6-8-10-12-14-16-18-20-24-30-36
 **PH**		Flush, Fixed Pattern, Half-Round	Ceiling	6-8-10-12-14-16-18-20-24
 **P3**		Adjustable Pattern (4 position)	Ceiling or Exposed Duct	6-8-10-12-14-16-18-20-24-30-36
PR		Flush, Fixed Pattern, Supply and Return	Ceiling	8-10-12-14-16-18-20-24-30-36
P-1		Deep Outer Shell	Alternate outer shell for all Type P Diffusers	6-8-10-12-14-16-18-20-24
S		Flush, Fixed Pattern	Ceiling	6-8-10-12-15-18-21-27-33-38
H		Flush, Fixed Pattern, Half-Round	Ceiling	8-10-12-15-18-21-27-33-38
ES		Stepped Down, Fixed Pattern	Ceiling or Exposed Duct	6-8-10-12-15-18-22-27-33

Ceiling Diffusers – Square and Rectangular



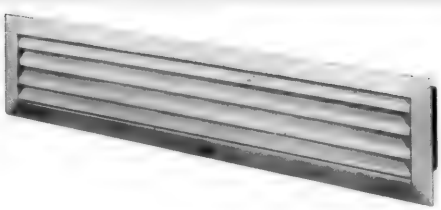
TYPE	DESCRIPTION	APPLICATION	LISTED SIZES
D	Fixed Pattern	Acoustical tile, exposed duct, or overlap ceiling.	6-8-10-12-15
DA	Adjustable Pattern	Ceiling or Exposed Duct.	6-8-10-12-15
DFP	Panel	Acoustical tile or T-bar.	6-8-10-12-15

TYPE M MULTI-PATTERN DIFFUSERS

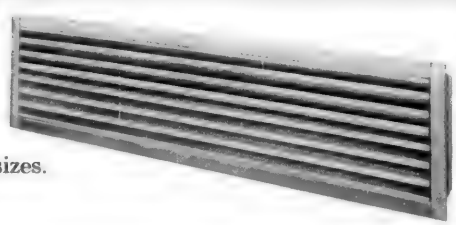


AIR PATTERN ARRANGEMENTS	MARGIN STYLE	APPLICATION	SIZES
4-WAY	MS-Beveled	Overlap ceiling	3 inch increments from 6 x 6 to 36 x 36
3-WAY	ME-Flat	Overlap ceiling	3 inch increments from 6 x 6 to 36 x 36
2-WAY	MF-Flush	Acoustical tile	3 inch increments from 6 x 6 to 36 x 36
1-WAY	MD-Drop Collar	Flush installation with surface mounted lights or exposed beams.	3 inch increments from 6 x 6 to 36 x 36

TYPE L LINEAR DIFFUSERS



One-way Blow.
3½″ and 6½″ listed sizes.

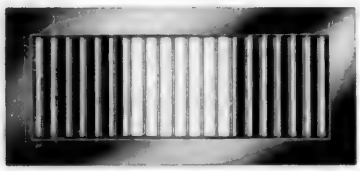


Two-way Blow.
7″ and 13″ listed sizes.

18-24-30-36-48-60-72″ lengths

Grilles and Registers

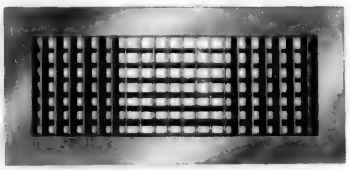
SUPPLY GRILLES



Single Deflection

T50 Horizontal Face Bars

T60 Vertical Face Bars

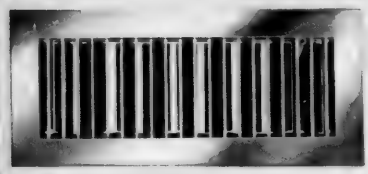


Double Deflection

T55 Horizontal Face Bars

T64 Vertical Face Bars

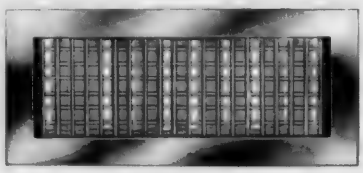
SUPPLY REGISTERS



Single Deflection

T57 Horizontal Face Bars

T67 Vertical Face Bars

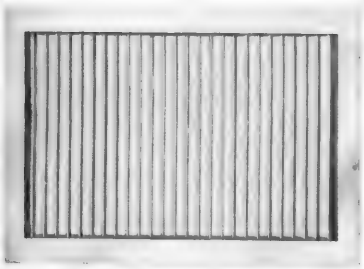


Double Deflection

T557 Horizontal Face Bars

T647 Vertical Face Bars

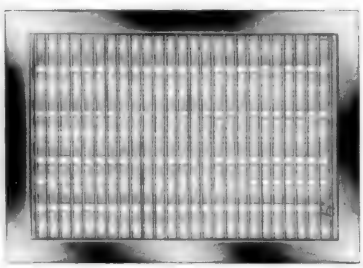
RETURN GRILLES



T70D Horizontal Bars set at 35° angle

T80 Vertical Bars set Straight

RETURN REGISTERS

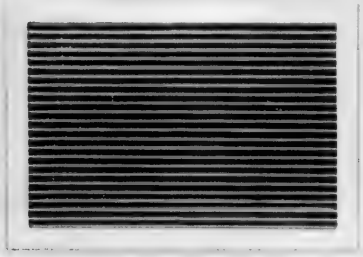


T78 Horizontal Face Bars

T88 Vertical Face Bars

RETURN GRILLES AND REGISTERS

with close-spaced bars



T110D — Grille — Horizontal Face Bars

T117D Register — Horizontal Face Bars

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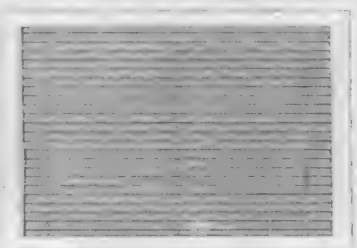
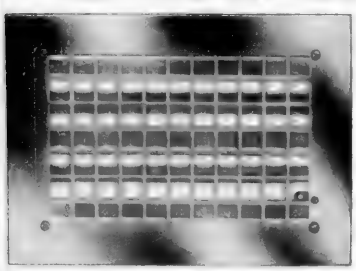
heavy-duty



T70DG Grille — Horizontal Face Bars

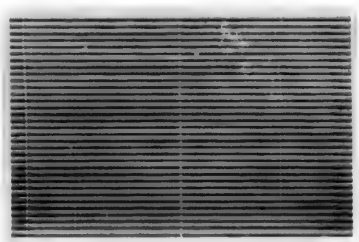
T77DG Register — Horizontal Face Bars

No. 7908 KEY OPERATED REGISTER



Also available as Slide Operated Register (No. 808)

T980 RETURN AIR AND DOOR GRILLES



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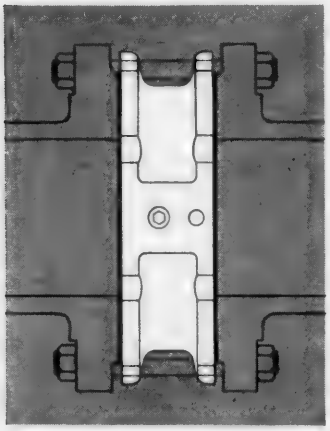

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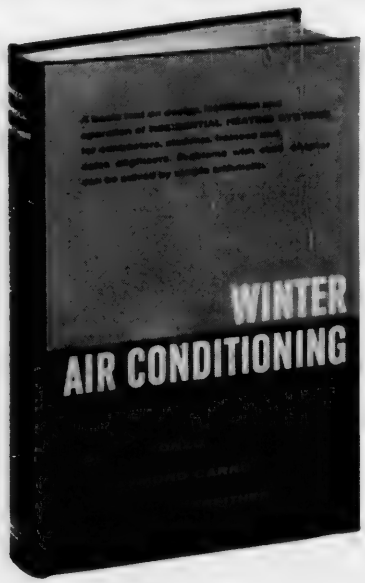

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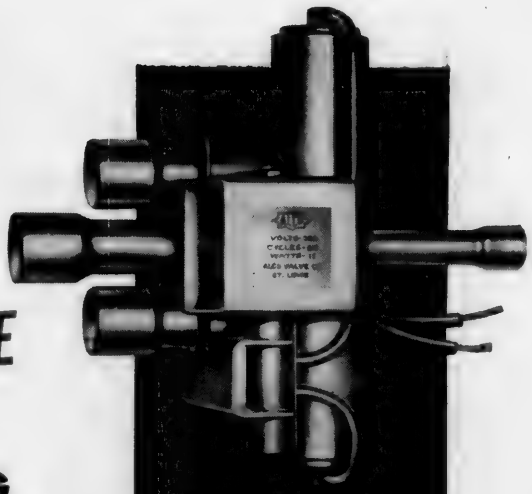

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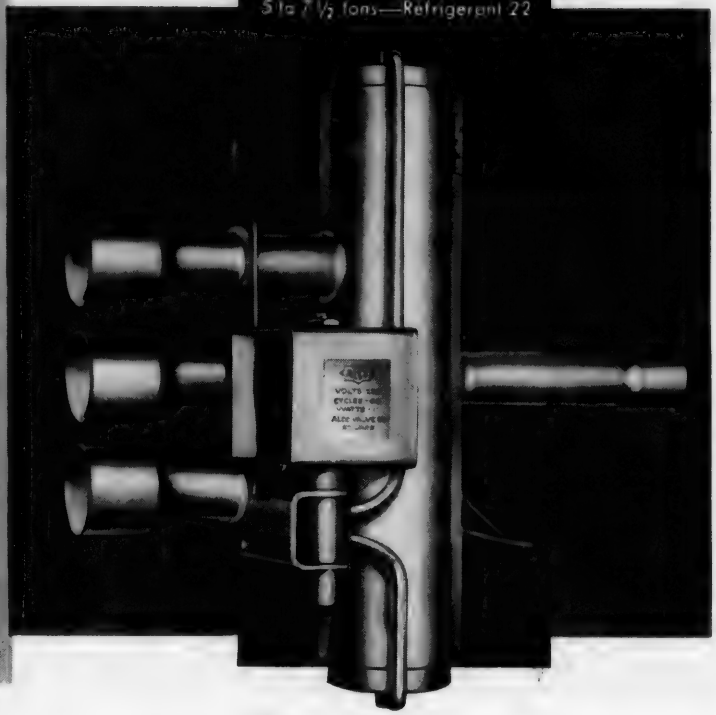

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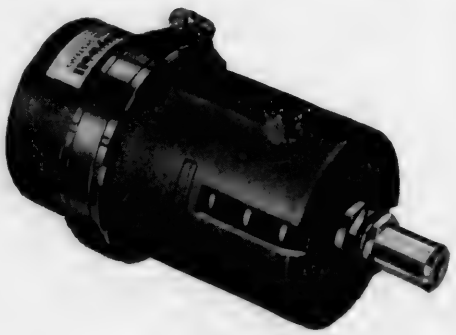

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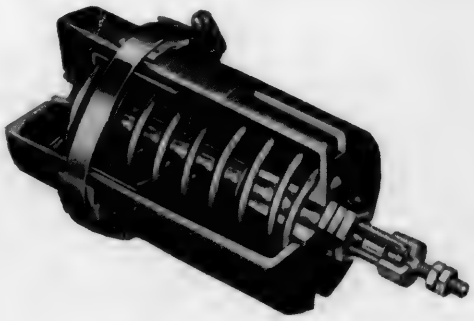

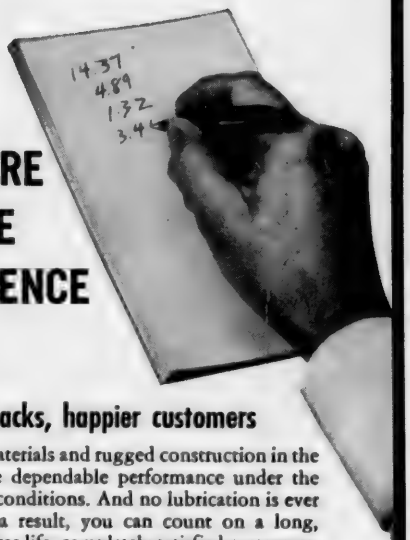

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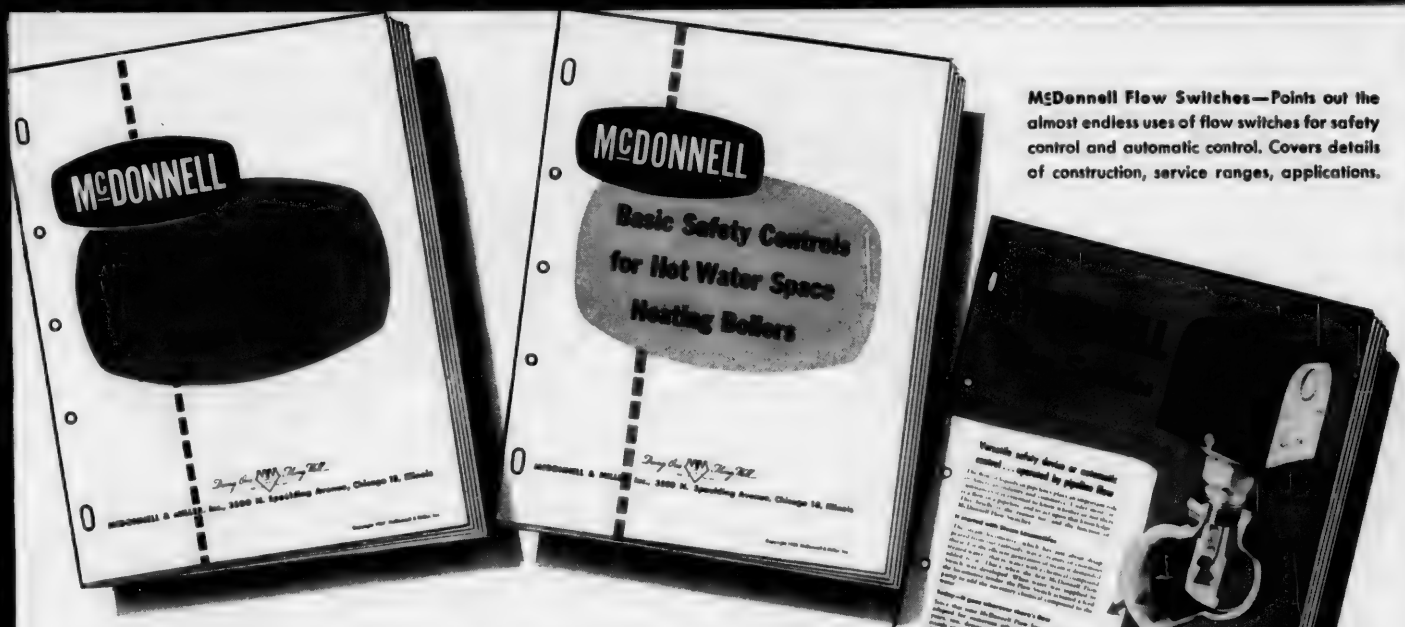

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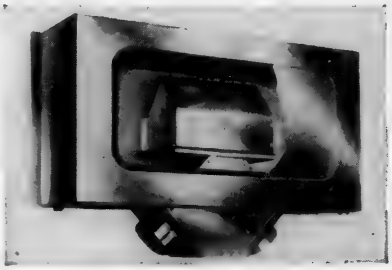

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AURORA®

Packaged

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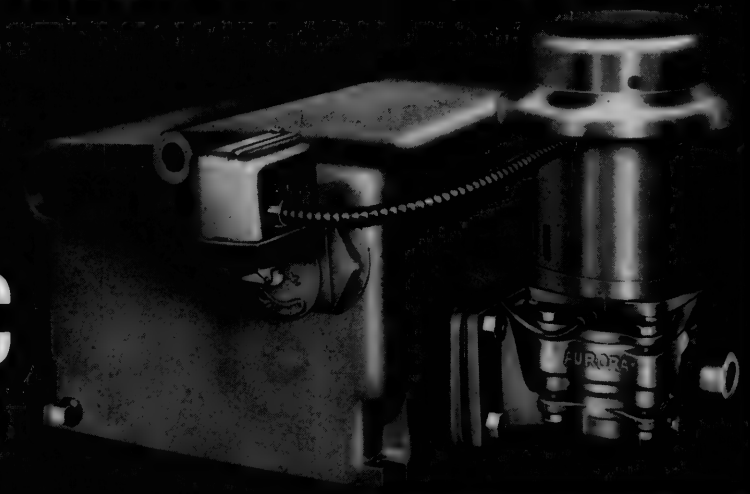
CONDENSATION RETURN UNITS



Capacities to 15000 EDR–To 23 GPM

- Low NPSH . . . smooth ultra-quiet operation . . . impeller design with curved inlet blade tips that minimize shock loss as the liquid enters the impeller.
- Stainless steel shaft—rigid design eliminates shaft deflection and assures longer life for seal or packing.
- Stainless steel seals . . . maximum corrosion resistance . . . longer trouble-free life.
- High efficiency . . . low horsepower requirement . . . less power is needed to provide required delivery . . . less initial cost and lower operating expense.
- Utmost compactness — minimum floor space requirements.
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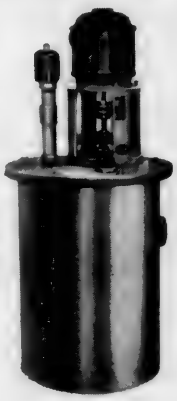
- Complete unit . . . ready for installation of lead lines.
- Self venting . . . will not vapor lock.
- Combination float switch and alternator optional when desired.
- Simplex or Duplex units.

Aurora Pump specialists are always available for consultation on your requirements

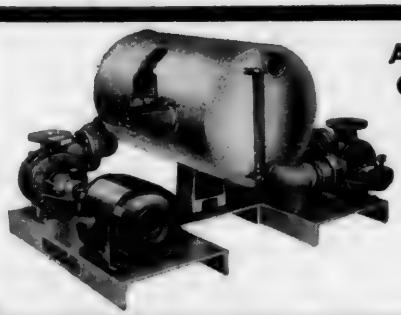
FOR GREATER CAPACITIES . . . OR SPECIAL CONDITIONS

VERTICAL UNITS

Capacities to 100,000 EDR 150 GPM



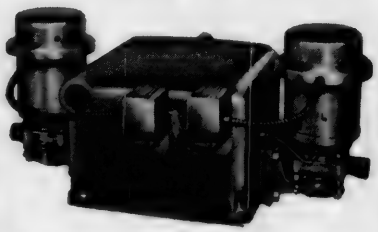
Ideal for applications where return is extremely low or below floor level.



APCO HORIZONTAL UNITS Capacities to 100,000 EDR 150 GPM

With automatic range adjustment, equalized pressure, and the many advantageous features of APCO Turbine Type Pumps

TYPE C HEAVY DUTY UNITS Capacities to 150,000 EDR 225 GPM



For high capacity or heavy duty applications. Packing Boxes on pumps optional when desired.

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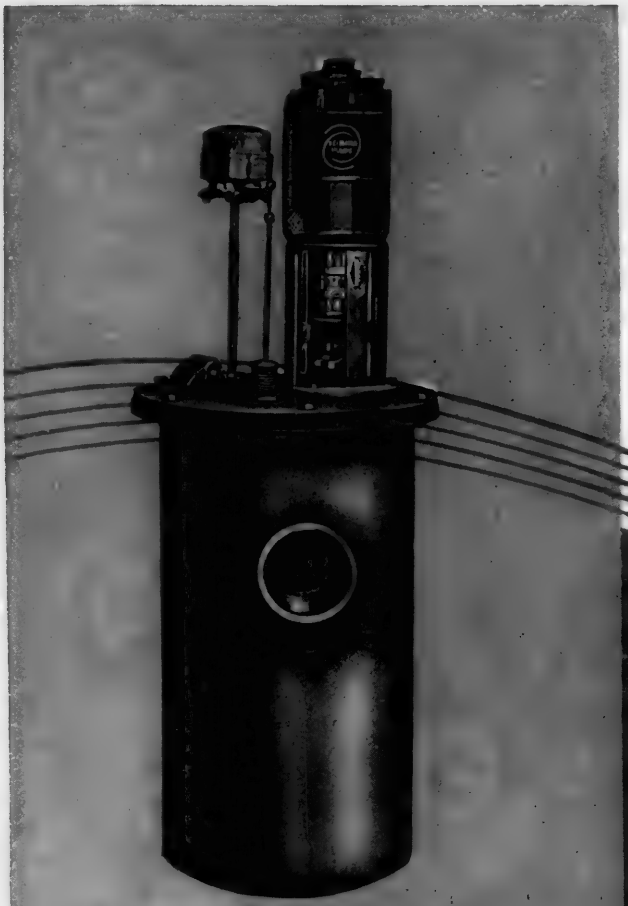
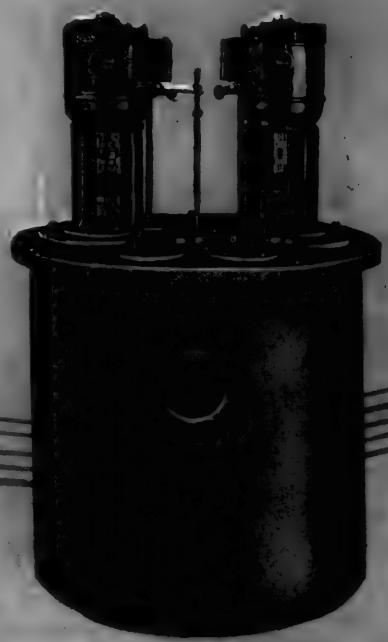


SKIDMORE SINGLE UNIT UV PUMP

SKIDMORE DUPLEX UNIT UV PUMP



SKIDMORE

Type UV condensate pump is ideal for return of condensate to the boiler or other points. Built in both single and duplex units . . . type UV pump can be installed with cover plate flush with floor . . . motor and float switches are easily accessible [illegible] level and out of danger.

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Skidmore Pumps have set a standard of performance and dependability since 1921.

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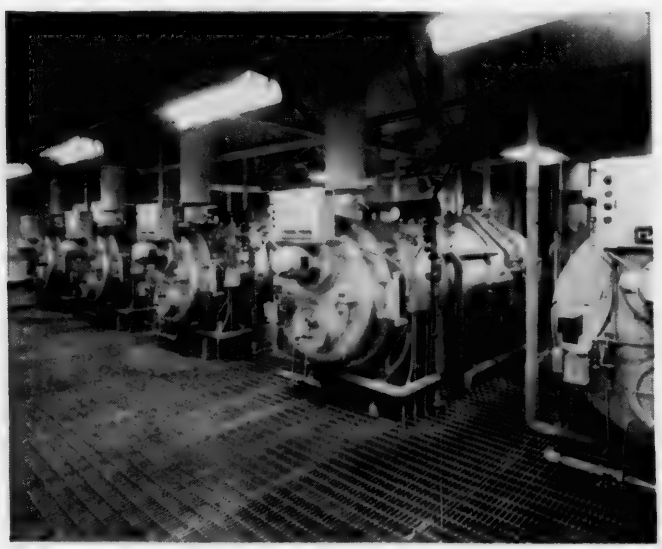
can you afford to recommend a boiler designed 20 years ago?

$15,000-A-YEAR LABOR SAVINGS

Diebold, Inc., Canton, Ohio, century-old manufacturer of bank protection and office equipment, replaced old, coal-fired boilers with new, fully automatic, gas-fired CB boilers and saved $15,000 to $18,000 in annual manpower cost. *All five of these new boilers are operated by just one man* — other personnel have been transferred to more productive work assignments. Bill Roby, assistant plant engineer, speaks highly of the ease of installation and the compact design.



New or old, there's one thing about any boiler that's up-to-date: your clients have to pay today's wages for the men who tend it. This becomes out-of-line overhead if they're operating a boiler designed in the days when man-hours were far less costly.

As wages have doubled during the past two decades, one manufacturer, Cleaver-Brooks, has pioneered in making a boiler that requires fewer man-hours to operate. Today's CB packaged boilers provide a combination of labor-saving design features and performance standards that cannot be found in any other boiler — at any price.

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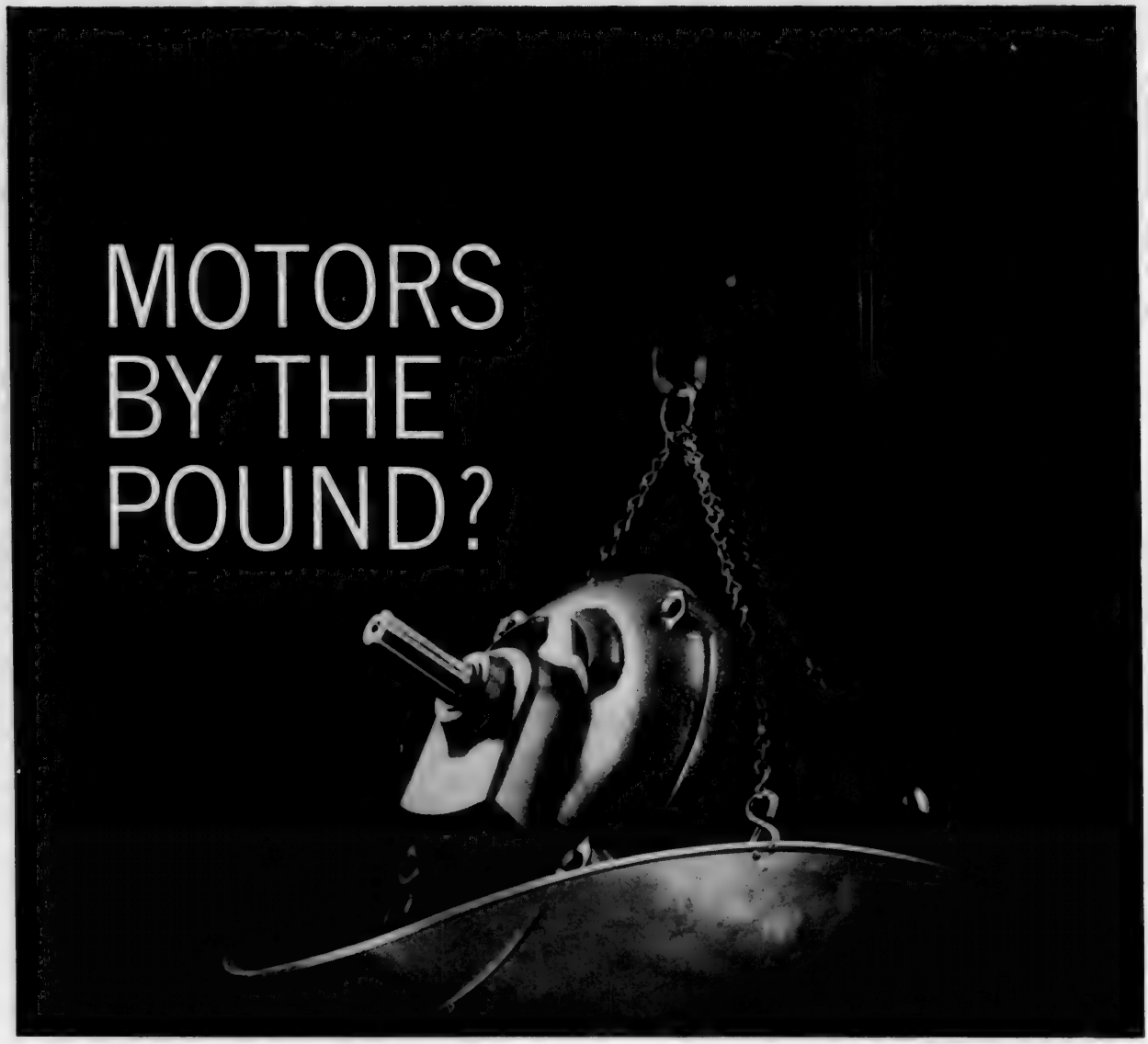

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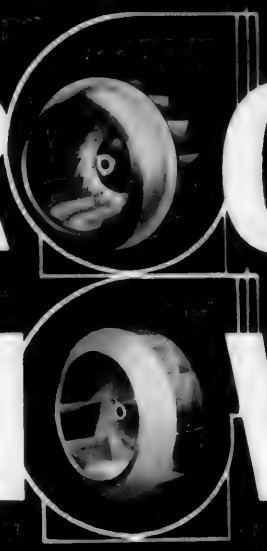

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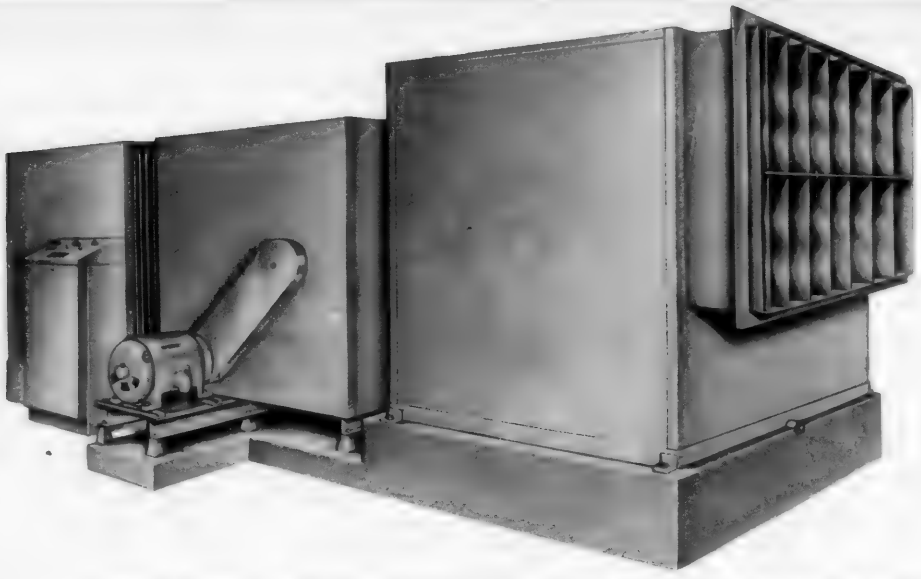

'BUFFALO' TYPE "PCHB" HIGH PRESSURE CABINETS... a new design incorporating the high quality 'Buffalo' type "BL" fan. Other unique features include: individual factory-sized zone dampers, horizontal or vertical up discharge; neoprene flexible connection between fan and coil sections, angled coils for minimum space requirements, with typical 'Buffalo' quality construction throughout. The unit at the show will also incorporate an Electronic Air Cleaner. Sound interesting? You bet it is. Here's a unit you will want to see close-up!

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THE 'BUFFALO' AIR COOLED CONDENSER... a recent design typical of 'Buffalo' superiority in "package" unit engineering and construction. A really low silhouette. Multiple fans for versatility. Unique opposed blade by-pass damper control for ultra-accurate performance. Rugged frame construction. This unit is shipped complete, ready to install. Many of these condensers are in the field giving unparalleled performance. Be sure not to miss this one! Next time you need an air cooled condenser, you'll be glad you took the time to learn about all the exclusive features of this 'Buffalo' unit.

BUFFALO, NEW YORK

"Buffalo"

BUFFALO PUMPS AT THE EXPOSITION

THE NEW 'BUFFALO' ECONOMY SINGLE SUCTION PUMP ... features in addition to a low price, full ball bearing construction, open type mounting and discharge position rotation. Parts are standardized and interchangeable. Rotor assembly removable without disturbing piping.

THE NEW 'BUFFALO' CLOSE-COUPLED PUMP ... a low cost compact package unit with a wide range of fresh water applications in industrial and air conditioning service. Standardized for parts interchangeability. Ball bearing design with mechanical seal, stainless shaft.

THE NEW 'BUFFALO' HERMETIC PUMP... a new design with wear compensating type bearings to take thrust loadings. Wide range of materials of construction. Pressures up to 400 psi. This is the pump to use where leakage would be costly or dangerous.

THE NEW 'BUFFALO' DOUBLE SUCTION PUMP... a modern, high efficiency design featuring standardization of parts for interchangeability. Suitable for working pressures up to 250 psi, temperatures to 300°F. A quality pump built for years of trouble free service.

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BUFFALO FORGE COMPANY

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'Buffalo' Air Handling Equipment to mix, heat, cool, dehumidify and treat air and other gases.

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Sprout Machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.

No. 2 in a series for your SPEC. FILE†

Suggested specifications for insulating OUTDOOR HEATED and CHILLED PIPING with G-B SNAP*ON® Glass Fiber PIPE INSULATION

DESCRIPTION

Versatility is the keynote to G-B Snap*On, the one-piece hinged pipe insulation molded entirely of fine glass fibers. Possessing all the characteristics of glass itself, G-B Snap*On will not deteriorate or lose its outstanding thermal efficiency even when exposed to extremely contrasting weather conditions. Available in a wide variety of weather-proof jackets, G-B Snap*On is your best insulation buy for chilled or heated piping to 350° F. temperatures. Lightweight and easy to handle and apply, G-B Snap*On provides positive insulation protection for the life of the installation.

MATERIAL SPECIFICATIONS

PLUMBING—thermal insulation for COLD WATER PIPING—ABOVE 50°

Insulating Material—All cold water service piping shall be insulated with Gustin-Bacon Snap*On glass fiber pipe insulation in one-piece molded sections ...." thick. Piping shall be clean and dry and shall be tested before insulation is applied.

AIR CONDITIONING & DUAL TEMPERATURE PIPING — thermal insulation for chilled water or combination hot and chilled water supply and return piping below 50° or up to 212° F.

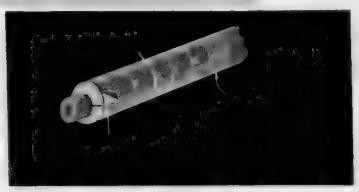
Insulating Material—All chilled water or dual temperature heating and cooling lines to air conditioning equipment and return shall be insulated with Gustin-Bacon Snap*On glass fiber pipe insulation in one piece molded sections ...." thick with factory-applied vapor barrier jacket. Piping shall be clean and dry and shall be tested before insulation is applied.

HEATED PIPING—thermal insulation for low pressure steam or hot water supply and return piping up to 350° F.

Insulating Material—All low pressure steam or hot water supply and return piping used for heating, located indoors in unconditioned areas or where touch-temperature insulation is required, shall be insulated with Gustin-Bacon Snap*On glass fiber pipe insulation in one piece molded sections ...." thick. Piping shall be clean and dry and shall be tested before insulation is applied.

APPLICATION SPECIFICATIONS

INSULATION OF OUTDOOR PIPING . . . WEATHERPROOF JACKET FACTORY APPLIED



The insulation shall be applied to the pipe with end joints tightly butted. The longitudinal seam shall be tightly closed and the insulation held to the pipe with separate loops of copper-clad wire on 4" centers.

End joints shall be weatherproofed with factory-furnished 4" wide strips of jacket material held in place with two separate loops of copper-clad wire and sealed, if specified, with asphalt emulsion. Longitudinal laps shall be placed at the side of the pipe facing downward, to shed water and sealed with asphalt emulsion if specified.

INSULATION OF OUTDOOR PIPING . . . WEATHERPROOF JACKET FIELD APPLIED

The insulation shall be applied to the pipe with end joints tightly butted and the longitudinal seam firmly closed with suitable copper-clad wire or insulation staples; four wire loops or staples per 3' of section length.

An asphalt saturated and coated weatherproofing jacket weighing not less than 35 lbs. per 100 sq. ft. shall be applied over the insulation with 3" laps at longitudinal and end joints, the laps sealed with asphalt emulsion when specified. The horizontal laps shall be made downward to shed water. The weatherproof jacket shall be tightly wrapped and held securely in place with separate loops of copper-clad wire spaced on 4" centers.

(CUT ALONG THIS LINE)

RECOMMENDED JACKETS FOR G-B SNAP*ON PIPE INSULATION FOR OUTDOOR PIPING

Ordering Name	Description	Sec. Length	Vapor Barrier	Where To Use
Weatherproof Roofing Jacket	A felt base, saturated and coated with asphalt. Available in standard weight: 35-lb., or for additional protection, 45 lb. or 55 lb. weights are available, all factory applied with a 2" longitudinal flap and 4" tapes for sealing end joints.	3'	No	On exterior lines requiring weather protection. Where a vapor barrier is required, a suitable jacket should be ordered factory applied with weatherproof roofing, aluminum, or other suitable material applied in the field over the vapor barrier.

†Complete series of G-B Snap*On specifications will appear in this publication in the coming months. Each will be designed to be clipped from the publication and placed in your spec. file. However, if you would like to have all G-B Snap*On specifications at this time, simply write:

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222 W. 10th St., Kansas City, Mo.

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Thermal and acoustical glass fiber insulations . . . Molded glass fiber pipe insulation . . . Couplings and fittings for plain and grooved end pipe

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PACKAGED ROOF-MOUNT AIR-CONDITIONING & HEATING SYSTEM

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Check these quality engineering features:

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2. Automatic electrical reset system.
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5. Draft inducers and draft proving controls.
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7. 2" foil fibreglass, reinforced insulation throughout.
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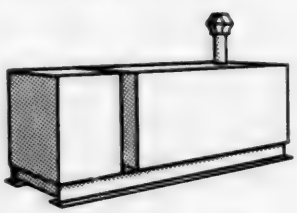
10. Available in 5, 7½, 10, 15 and 20 Ton, for use with or without duct work, oil or gas.

For flexibility and economy — **VENTIL-AIRE** Packaged Roof-Mounted System offers **MORE BENEFITS** for year-round air-conditioning and heating **without the loss of valuable floor space!**



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One job he couldn't handle — would be to break a Wade floor drain with Golden Ductile iron grate.

Golden Ductile combines the strength of steel with corrosion resistance, superior to galvanized cast iron.

It can be the answer to one of your jobs — providing drainage in areas subject to high impact loads.

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Corrosion-resistant, fireproof vents

...with eye-appeal!

Vertical exposed flues of Transite Vent Pipe form eye-catching design on new Rockwell Manufacturing Co. installation

A GLANCE at this attractive new plant tells you that the material used for the exhaust flues is vital—vital to the plant's appearance . . . vital to maintenance economy.

That's why Walter Wagner & Partners, Architects & Engineers of Fresno, Calif., chose Transite Industrial Vent Pipe to exhaust corrosive fumes from the plant's small parts casting pots.

Made of asbestos-cement, Transite® retains its good appearance through years of weather. *Saves on upkeep*, because it never needs painting or preservative coating. *Saves on maintenance*, because it resists the attack of most gases, mists, fumes, and dusts. Installed indoors or out, Transite offers you these same appearance and maintenance-free advantages.

Transite also offers many layout and installation economies. A wide variety of fittings, diameters and lengths makes it readily adaptable to every venting service. Ease of cutting and handling add further to installation savings.

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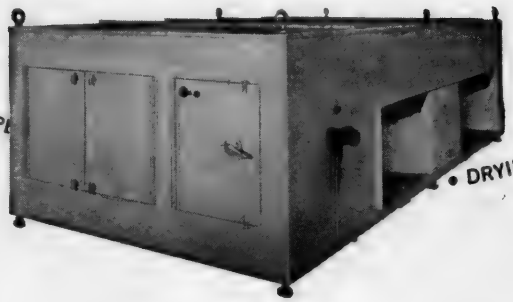
National Champion MA (makeup air)



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whatever your heating requirements

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For heating or makeup air, you can place your confidence in National Champion!

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FIRST IN THE SPACE HEATING INDUSTRY

National Champion, Series ITD. 6 styles, 96 sizes —capacities 400,000 to 4,000,000 BTU's with gas, oil or combination fuel. UL & AGA approved.

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It's a NASH Heating Pump, PLUS!

The type CSI NASH Heating Pump sets a new standard of economy

Now a Nash quality Vacuum Heating Pump can be economically installed and operated on any steam heating job. Engineered for high performance and low installed first cost, this new pump still makes use of time tested Nash principles of operation.

The Nash CSI has generous air capacity and features a wide choice of water capacities and discharge pressures. The right combination of capacities is at hand to match the requirements of the job. It is no longer necessary to pay extra for a pump with excessive water capacity, excessive discharge pressure, or in an attempt to get adequate air capacity.

With this advanced design, Architects, Engineers and Contractors will find answers to many heating system problems. Send for bulletin now.

1. ECONOMY IN FIRST COST
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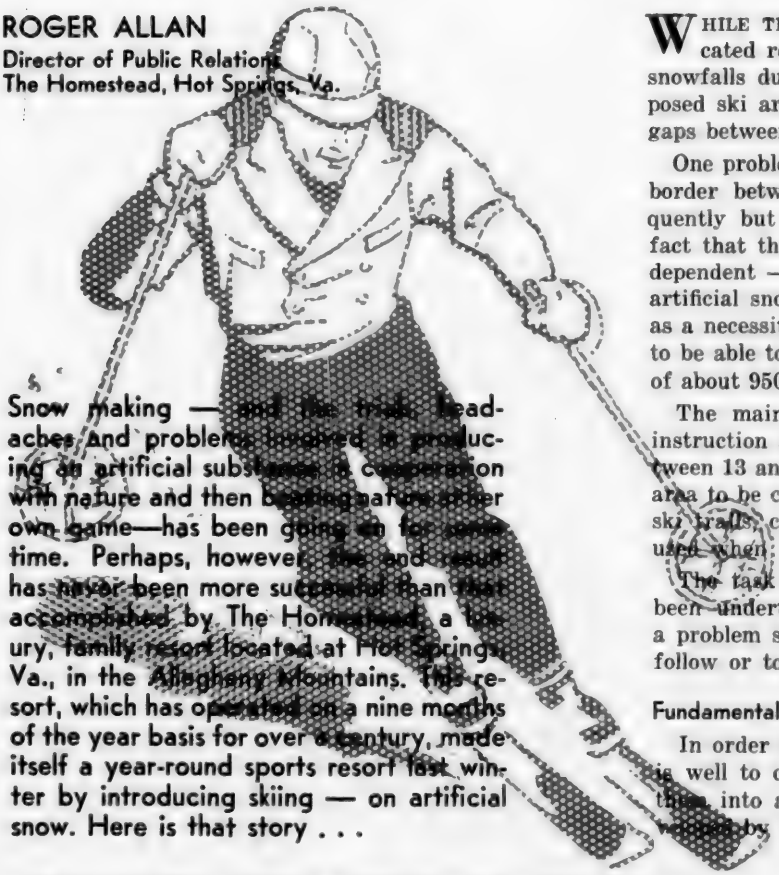
NASH ENGINEERING COMPANY
449 WILSON, SO. NORWALK, CONN.

DESIGN FOR ARTIFICIAL SNOWFALL

ROGER ALLAN
Director of Public Relations
The Homestead, Hot Springs, Va.



Snow making — and the trials, headaches and problems involved in producing an artificial substance in competition with nature and then beating nature at her own game—has been going on for some time. Perhaps, however, the end result has never been more successful than that accomplished by The Homestead, a luxury, family resort located at Hot Springs, Va., in the Alleghany Mountains. This resort, which has operated on a nine months of the year basis for over a century, made itself a year-round sports resort last winter by introducing skiing — on artificial snow. Here is that story . . .

WHILE THE AREA in which The Homestead is located receives frequent, but light and scattered, snowfalls during the winter, the success of the proposed ski area depended on artificial snow to fill the gaps between snowfalls.

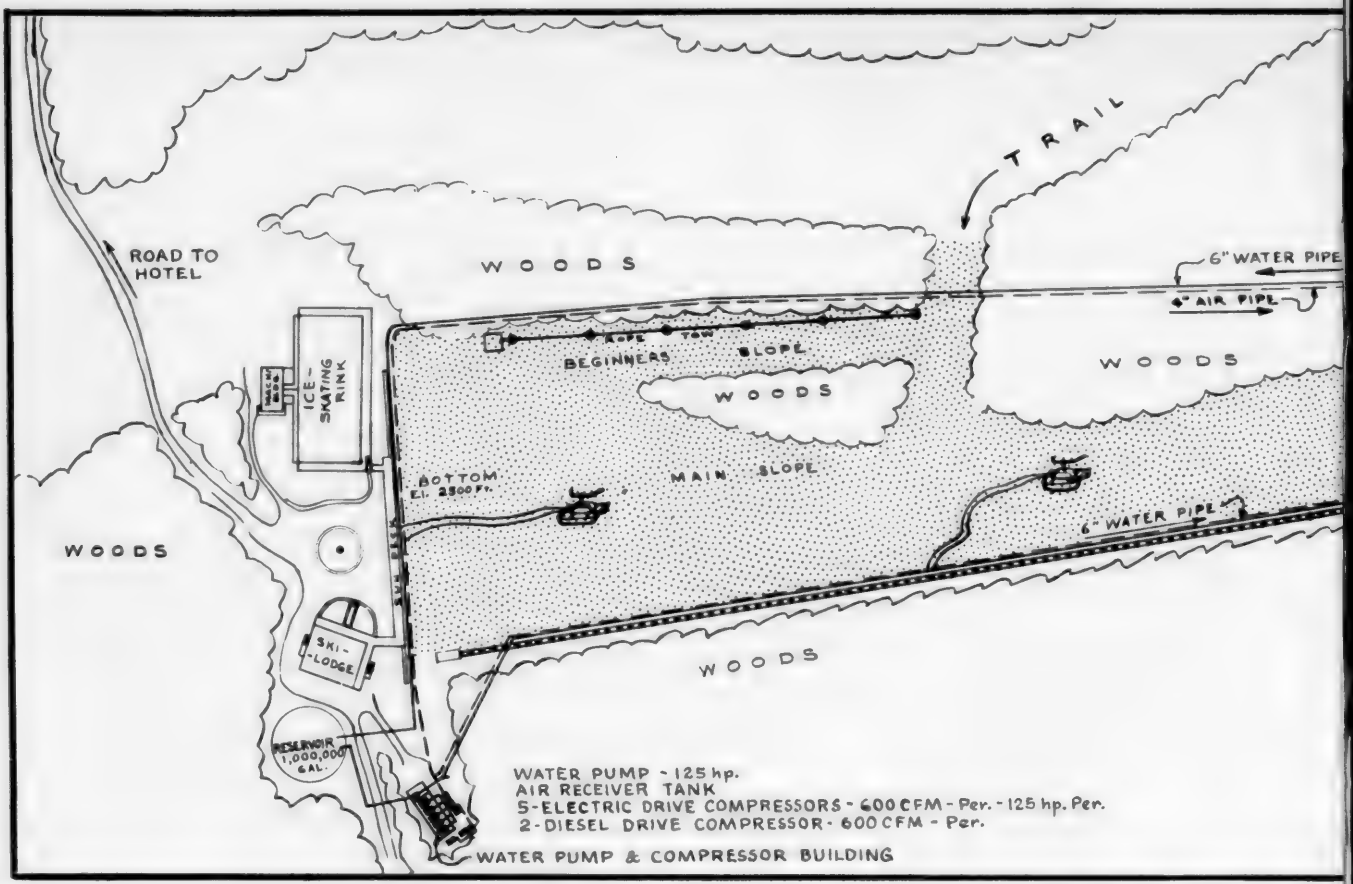
One problem was the location of the resort. On the border between North and South, the area is frequently but not dependably cold. Another was the fact that the Homestead would be relying — almost dependent — on artificial snow. (Other areas using artificial snow equipment use it more as an aid than as a necessity.) Therefore, the engineers had to plan to be able to cover the entire skiing surface—an area of about 950,000 sq ft.

The main slope, which includes a ski school or instruction area, contains about 600,000 sq ft or between 13 and 14 acres of land. This was the principal area to be covered. In addition to this, there are two ski trails, containing about 350,000 sq ft, which are used when natural snow covers the ground.

The task of covering so large an area had never been undertaken before, which in itself constituted a problem since the engineers had little precedent to follow or to take example from.

Fundamentals of Snow Making

In order to understand the snow making process it is well to consider a few definitions and work from these into a practical analysis of the process as developed by The Homestead.



Artificial snow is made by a "snow machine," which comprises the component parts of equipment necessary for the production of snow. These consist of the pipe lines (air and water lines, usually made of aluminum), air compressors, water pumps, hoses, couplings to attach the hoses to the pipe lines, and finally the "snow gun" itself.

The engineers determined that it would take 500 gallons of water per minute to make snow. Of this amount, 360 gallons were needed for actual discharge in snowmaking and 140 gallons were needed for circulation.

Circulating water is necessary to prevent buildup of ice inside the main water pipe wall. Ice buildup led to the selection of the six-inch water pipe line.

Water for the Homestead's ski area is drawn from a 1,000,000 gallon tank reservoir. The reservoir also supplies water to the town of Hot Springs and to The Homestead Hotel.

Water for the ski area is gravity fed to a 125-hp pump at the base of the main slope. Adequate pressure is maintained in this pipe only about two-thirds of the way to the top of the slope. (Water will reach the top with enough pressure to start down the loop on the opposite side of the slope, but with inadequate pressure to make snow.) For this upper two-thirds of the slope, another supply of water is connected to a 20-hp pump to maintain pressure.

As the water flows down the opposite side, there is a pressure reducing valve in the main line about halfway down the slope which maintains a more satisfactory pressure range (100 to 200 psi) below that point. Since pressures greater than 150 pounds are difficult to control, small reducing valves are frequently placed in the hose connections to the snow guns. The main water and air lines are tapped for hose connections at 40-ft intervals throughout the pipe line system. Typical connections are shown in Fig. 2.

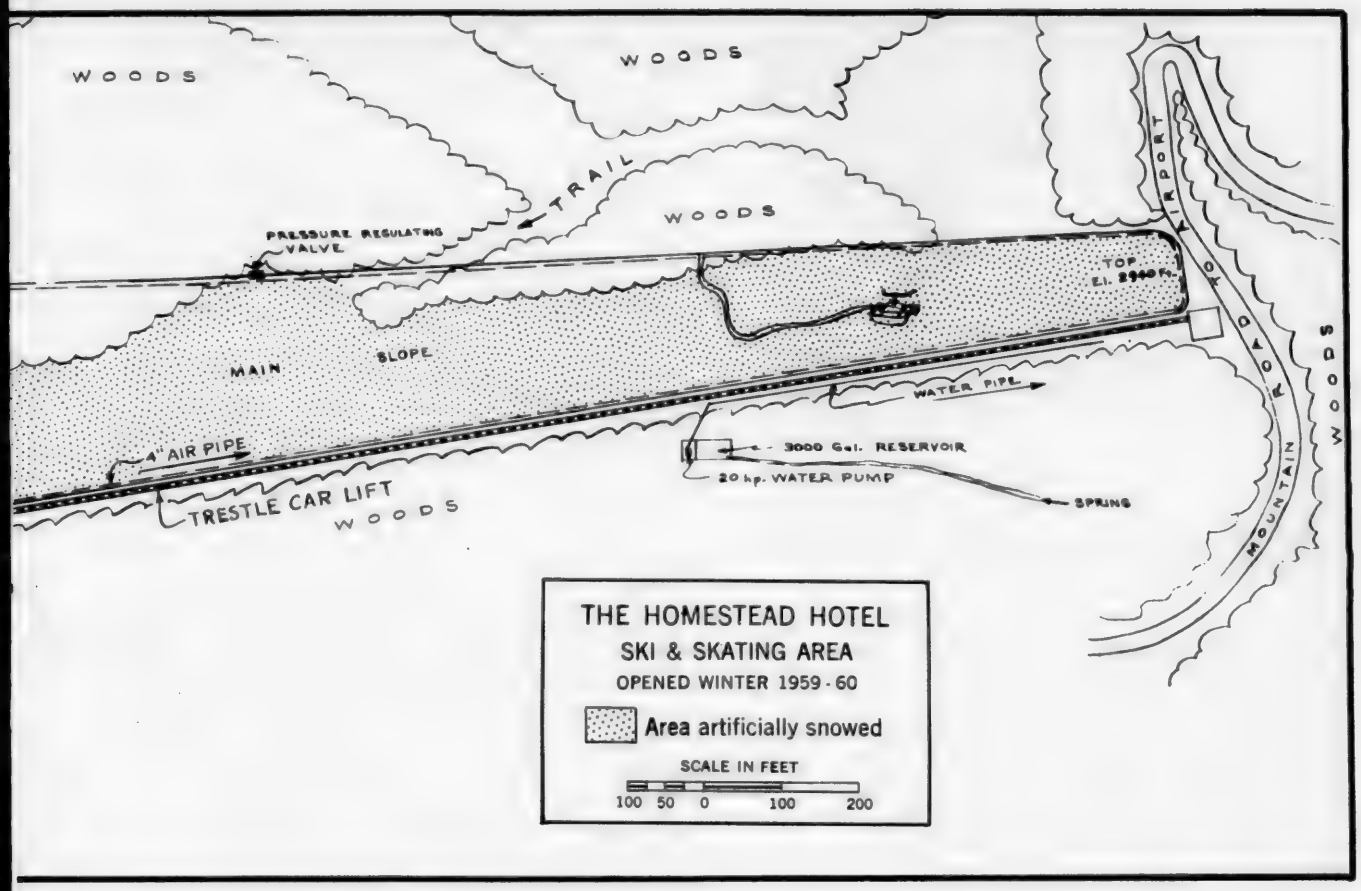
Delivery to the snow gun itself is predetermined not to exceed 12 gallons of water per minute. Therefore, the 360 gallons of discharge water can supply a maximum of 30 snow guns, which can be in use at one time.

The main pipe lines are laid directly on the ground around the border of the slope. In some places, the pipe lines are secured off the ground and in a few cases the lines are underground.

Summing up the water principle: the standard is 12 gallons of water per minute per snow gun, regardless of where the gun is on the slope, at 100 to 150 pounds per square inch pressure.

The other element in snowmaking is air.

Air is pumped through four-inch aluminum pipes by means of five electric motor driven air compressors. Each compressor, of 600 cfm capacity, is driven by a



125-hp motor. To supplement these five compressors, two diesel driven 600-cfm compressors are also used.

The compressors are banked into a centrally-located air receiver tank, 4 ft in diameter and 20 ft in length. From this tank, a six-inch pipe feeds two 4-inch pipes, which are laid parallel to the main water pipe line. The air pipes go up opposite sides of the slope and join at the top, forming a loop.

Outlets on the pipes for the air hoses are paired with the corresponding outlets on the water main.

A standard of 100 cubic feet per minute at 100 psi is set for the air outlets.

From the water and air pipes circling the ski area, hoses lead off to the snow guns.

Types of Snow Guns

There are various types of snow guns. One type is actually a modified revolving irrigation sprinkler. It has been modified at the base, having a mixing chamber provided with couplings for the air and water hoses. The action in the mixing chamber is given access to the revolving nozzles which discharge an atomized spray, or mist.

These nozzles can lay down a base of snow varying up to 75 ft in diameter. A snow gun of this type is shown operating in photo at heading of article.

The Homestead uses this type of snow gun, as well as one developed by the engineers here. This latter gun consists of common pipe and fittings arranged so that air and water streams intersect at a predetermined point, not in a mixing chamber. Experiments with this gun are continuing, and the Homestead's engineers are not yet ready to recommend their studies of their own type of snow gun, shown operating in Fig. 1, next page.

These snow guns, of any type, discharge a fine mist into the air. During the period from discharge to settlement on the ground, freezing temperatures form the snow.

It must be noted and stressed that snow cannot be made unless temperatures are below freezing. Homestead engineers have found that the ideal snow-making temperature is 28 deg F and lower—preferably lower.

The foregoing information is basic for any snow-making operation any place in the country. Variables, such as the quantity of air and water to be used, are determined by the size of the area to be covered.

Operation at The Homestead

The snowmaking apparatus comprised of 30 snow guns was determined necessary in order to produce a minimum coverage of four inches of snow over one-third the area of the ski slope in one night of operation under ideal conditions.

Fig. 1. This snow gun was devised by The Homestead's engineering staff and, unlike the "irrigation sprinkler" type, causes streams of air and water to intersect at a predetermined point, rather than mixing in a chamber.

Coverage is based on an area of 200,000 sq ft, one-third the main skiing area, and is figured in terms of an 8 to 10 hour period of operation, which is usually during the night.

The engineers have found that the best snowmaking period, in this area, is after midnight when the temperatures usually begin to drop and remain low until about 7 a.m. However, snow can be made in the daytime, even if the sun is shining, when the temperature is under 20 deg.

The Homestead took advantage of every minute of cold weather. During some periods, snow machines were in continuous operation for over 130 hours.

A typical snowmaking day will find a crew of men ready at 6 p.m., depending on the temperature. When the thermometer reads about 28 deg, or preferably below, the compressors are started and a supply of air is built up in the receiving tank.

The crew, usually four men and a supervisor, begins placing the snow guns on the slope in the area designated to be snowed down.

Hoses, which have been drained and dried in a utility building in order to prevent ice plugs, are coupled from the snow guns to the water and air mains. When all is in position, the valves at the mains being still closed, the water pump is started and the main water pipe line is filled and started circulating back to the reservoir.

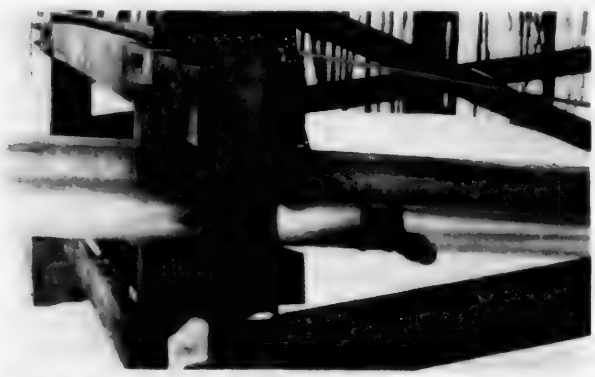


Fig. 2. Shown in the framing for the trestle car lift are main air and water lines, and a set of outlets to which hose lines, leading to a snow gun, can be coupled.

The main air pipe line is activated and, with two men to each gun, the valves are opened from the main lines to the gun and adjustment for the amount of water is made under the direction of the supervisor.

Regulation of water is made purely on the visual and physical judgment of the supervisor. To do this, he will get out in the spray, feeling and observing the spray on his face and hands. He can then decide whether more or less water is needed.

The air valve to the snow gun is usually wide open and the valve from the main pipe line has been sized to let a maximum of 150 cfm of air through. Everything is valved for maximum output but valves can be closed down. For example, the lower the temperature, more water and less air are used. If the snow is wet, cut down on the water and increase the amount of air.

The speed of the revolving sprinkler is mechanically regulated according to the temperature. For example, the colder the temperature, the faster the sprinkler can revolve and the closer to the ground the spray can be discharged.

To get all the snow guns in operation, with two teams of two men each, takes about an hour.

Constantly, during the operation, the crews must retrace their steps, testing the spray and regulating the valves. This is to insure that the ground does not become covered with water, later causing ice spots or slush areas.

If snow is being made for the first time, the ground must be cold and hard. The first spray covering the ground should be wet in order to form an ice layer of several inches which will provide an insulating blanket.

The spray should then be regulated so that the density of the snow becomes lighter and drier to provide a good skiing surface. After this is attained, the snow is built up to obtain a desirable depth over the area. At this writing, the total depth of snow at The Homestead is 48 inches; at least 40 inches of this is man-made.

As the temperature drops through the night, the amount of water supplied to the snow gun is increased to produce a greater amount of snow.

Workmen must vigilantly watch for possible "freeze up" of a snow gun. The freezing of one gun can greatly slow the entire snow making process. For this reason, extra snow guns are usually kept in readiness. If a gun freezes, a substitute can immediately be placed into action.

Engineers here feel that artificial snow is of a better quality than natural snow for skiing because it is denser. If it is dry enough, artificial snow will last longer than natural snow and provides a faster skiing surface.

Artificial snow has solved an old problem at The Homestead: that of attracting business during the winter months. The credit for the quantity and quality of the snow goes to the resort's engineering department, headed by Carl J. Wallin.

Industry Sets Stage in Chicago

WHAT is generally believed will be the largest gathering of engineers ever assembled in the air conditioning, heating, ventilating and refrigeration fields, will take place in Chicago, Ill., February 13 to 16. Dual attractions will be the semi-annual meeting of ASHRAE at the Conrad Hilton Hotel, and the International Heating and Air Conditioning Exposition at the International Amphitheater.

The convention program consists of four technical sessions, six forums and four symposiums. Following are the papers to be presented and the sessions to be held:

MONDAY, February 13

9:30 a.m. First Technical Session

Corrosion Inhibition in Steel Tubes in Low-Pressure Steam Boilers—W. A. Keilbaugh, Head, and F. J. Pocock, Senior Chemist, Chemical Section, Babcock & Wilcox Co., Research Center, Alliance, Ohio

Evaluation of Wet Cell Air Humidifiers—Dr. M. W. First, Consulting Engineer, Newton, Mass.

Metastability of Liquids in Heat Exchangers—B. H. Jennings, Prof. of Mech. Engrg., Northwestern University, Evanston, Ill.

Flow and Heat Exchange Characteristics of Finned Tube Exchangers—Benjamin Gebhart, Assoc. Prof. of Mech. Engrg., Cornell University, Ithaca, N. Y.

9:30 a.m. Second Technical Session—Insulation

Field Laboratory for Heating Tests—D. B. Anderson, Tech. Asst. to V.P. of Sales, G. A. Erickson, Dir. of Tech. Sales Service; R. R. Leonard, Res. Engr., Wood Conversion Co., St. Paul, Minn.; Dr. R. C. Jordan, Head, Mech. Engrg. Dept., Univ. of Minnesota, Minneapolis, Minn.

Thermal Conductivity of Porous Materials — Dean Melvin Mark, Lowell Tech. Inst., Lowell, Mass., and M. E. Stephenson, Jr., Consulting Engr., Winfield, Ill.

Heat Transfer through Mineral Wool Insulation in Combination with Reflective Surfaces—C. E. Lund, Professor, and R. M. Lander, Res. Assoc., Dept. of Mech. Engrg., Univ. of Minnesota, Minneapolis, Minn.

Thermal Effects of Floor Construction—R. D. Cramer, Asst. Prof. of Housing, Dept. of Home Economics, and L. W. Neubauer, Assoc. Prof., Dept. of Agric. Engrg., Univ. of California, Davis, Calif.

2:30 p.m. Forums

Transport Refrigeration
Moderator: P. R. Achenbach, Chief, Mech. Systems Section, National Bureau of Standards, Washington, D. C.

A New Psychrometric Chart
Moderator: John Everetts, Jr., ASHRAE 2nd Vice-President, C. S. Leopold, Inc., Phila., Pa.

TUESDAY, February 14

9:30 a.m. Third Technical Session—Refrigeration

Evaluation of Wet Bulb Data for Cooling Equipment Design—L. W. Crow, Consulting Meteorologist, Denver, Colo.

Reaction of Dichlorodifluoromethane with Petroleum Oils—Dr. H. O. Spauschus, Res. Assoc., and G. C. Doderer, Chemist, Major Appliance Div., General Electric Co., Louisville, Ky.

Sizing of Refrigeration System Pipelines for Optimum Economy—D. J. Renwick, Assoc. Prof. of Mech. Engrg., Michigan State University, East Lansing, Mich.

Graphical Analysis of Cross Flow Cooling Tower—Prof. Hideo Uchida, Dept. of Mech. Engrg., Univ. of Tokyo, Tokyo, Japan

9:30 a.m. Medium Temperature Water Heating Symposium

Pipe and Pump Size Reduction with MTW Systems—Homer Bird, Bird, Bird, and Associates, Osseo, Minn.

Heat Transfer—Effect of Increased Temperature Drop on Valve Control—S. W. Miller, Chief Engr., J. J. Nesbitt, Inc., Philadelphia, Pa.

Effect of System Temperature on Pump Curve and and Pressure-Drop Curve—G. F. Carlson, Chief Engr., Specialty Div., Bell & Gossett Co., Morton Grove, Ill.

Pressurization of MTW Systems—Raymond Harmon, Consulting Engr., Harmon & Beckett, Denver, Colo.

9:30 a.m. Air Conditioning Symposium—Air Movement, Humidity, and Humidity Control

Chairman W. R. Moll, Sales Mgr., Air Cond. & Dehumidifier Sales-to-Sears, Whirlpool Corp., Evansville, Ind.

Comfort and Physiological Adjustment of People to Environment—Prof. M. K. Fahnestock, Dept. of Mech. Engrg., Univ. of Illinois, Urbana, Ill.

Air Motion and Movement—Dr. R. G. Nevins, Dept. of Mech. Engrg., Kansas State Univ., Manhattan, Kan.

Humidity and its Control in Residential Air Conditioning Systems—Richard Signorelli, Asst. to V.P. of Manufacture, Mueller Climatrol, Milwaukee, Wis.

Control of Humidity on Window-type Air Conditioners—F. T. Appel, Projects Mgr., Air Cond. Div., Whirlpool Corp., Evansville, Ind.

2:00 p.m. Forums

Better Environments for Learning
Moderator: J. D. Kroeker, Consulting Engr., J. D. Kroeker & Associates, Portland, Ore.

Corrosion of Air Conditioner Components
Moderator: C. O. Hutchinson, Mgr., Market Dev., Industrial Paint Div., The Glidden Co., Cleveland, Ohio

WEDNESDAY, February 15

2:00 p.m. Forums

Aluminum Brazing and Welding Techniques
Moderator: A. J. Haygood, Alcoa, New Kensington, Pa.

Status of Thermoelectric Refrigeration
Moderator: G. D. Hudelson, Dev. Dept., Carrier Research & Dev. Co., Syracuse, N. Y.

THURSDAY, February 16

9:30 a.m. Ventilation Symposium—Performance Determination in Installed Systems

Field Check of Ventilation and Air Conditioning Systems—James Bricker, C. S. Leopold, Inc., Philadelphia, Pa.

Industrial Ventilation Systems—K. E. Robinson, Personal Hygiene Dept., General Motors Corp., Warren, Mich.

Ventilation Systems with Special Requirements—R. J. Walker, Plant and Process Engrg. Group Leader, Dow Chemical Co., Denver, Colo.

9:30 a.m. Fourth Technical Session

Combustion-Driven Pulsations in Oil-Fired Residential Heating Equipment—A. A. Putnam, Staff Mech. Engr. and C. F. Speich, Principal Mech. Engr., Battelle Memorial Inst., Columbus, Ohio

Noise Suppression in Oil Burners—R. W. Sage, Section Head, and H. F. Schroeder, Res. Engr., Prods. Des. Div., Esso Research & Engrg. Co., Linden, N. J.

Suppression of Pulsations in Oil-Fired Residential Heating Equipment—C. F. Speich, Principal Mech. Engr., and A. A. Putnam, Staff Mech. Engr., Battelle Memorial Inst., Columbus, Ohio

Influence of the House on Chimney Draft—A. G. Wilson, Head, Bldg. Services Section, Div. of Bldg. Research, National Research Council, Ottawa, Ont., Canada

Following are the list of exhibitors at the International Heating and Air Conditioning Exhibition and the respective booth numbers.

935 Ace Engineering Co., Chicago, Ill.

N-134 Ackerman Gas Burner Corp., McDonald, Pa.

1133 Acme Engineering & Mfg. Corp., Muskogee, Okla.

854 Acme Industries, Inc., Jackson, Mich.
864

1110 Addison Products Co., Addison, Mich.
1114

120 Aeroquip Corp., Jackson, Mich.

214 Aeronautical Electronics, Inc., Raleigh, N. C.

1103 Air Conditioning & Equipment Corp., New York, N. Y.

N-422 Air-Con Filter Corp., Memphis, Tenn.

751 Air Conditioning, Heating & Ventilating, New York, N. Y.

1015 Air Devices, Inc., New York, N. Y.

1128 Airfloor Co. of Calif., Santa Fe Springs, Calif.

407 Air Control Products, Inc., Coopersville, Mich.

1046 Air Guide Plastics Corp., Miami, Fla.
1048

1020 Air-Heet Corp., Chicago, Ill.

N-247 Air Motion Research Div., Missile Dynamics Corp., Lynwood, Calif.

N-312 Air-Fan Engineering Co., Los Angeles, Calif.
N-314

1145 Airserco Mfg. Co., Pittsburgh, Pa.

1159 Airtemp Div., Chrysler Corp., Dayton, Ohio
1169

217 Airtex Corp., Chicago, Ill.

1058 Ajax Boiler & Heater Co., Gardena, Calif.
1060

932 Alco Valve Co., St. Louis, Mo.

1051 Aldrich Co., Wyoming, Ill.

556 Allen-Bradley Co., Milwaukee, Wis.
558
560

1049 Allis Co., The Louis, Milwaukee, Wis.

672 Alnor Instrument Co., Div., Illinois Testing Laboratories, Inc., Chicago, Ill.

40 American Air Filter Co., Inc., Louisville, Ky.

1038 American Coolair Corp., Jacksonville, Fla.
1040

54 American Engineering Co., Kansas City, Mo.

N-315 American Furnace Co., St. Louis, Mo.
N-317
N-321

520 American Gas Assn., New York, N. Y.
522
633

841 American Gilsonite Co., Salt Lake City, Utah

709 American Iron and Steel Inst., Committee of Steel Pipe Producers, New York, N. Y.

1056 American Metal Mfg. Co., Dallas, Texas

N-320 American Pullman Co., Inc., Chicago, Ill.

701 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., New York, N. Y.

American Standard
26 Air Conditioning Div., New York, N. Y.
24 Detroit Controls Div., Detroit, Mich.
106 Industrial Div., Detroit, Mich.
20
22

23 Plumbing and Heating Div., New York, N. Y.
27

N-112 American Tube Products, Inc., West Warwick, R. I.

650 American Warming & Ventilating Co., The, Toledo, Ohio

429 Ammerman Co., Inc., Stillwater, Minn.

1018 Anderson Co., The V. D., Div., International Basic Economy Corp., Cleveland, Ohio

29 Anemostat Corp. of America, New York, N. Y.

966 Ansul Chemical Co., Marinette, Wis.

N-434 Apextro Products Co., Los Angeles, Calif.

N-130 Argo Industries, Inc., Hartford, Conn.
N-132

526 Arkla Air Conditioning Corp., Little Rock, Ark.
532

766 Arkon Mfg. Co., Cleveland, Ohio

N-108 Arkos Mfg. Co., Div., Arnold A. Kosarin & Associates, Inc., Detroit, Mich.

1207 Armco Steel Corp., Middletown, Ohio

1042 Armstrong Cork Co., Lancaster, Pa.
1044

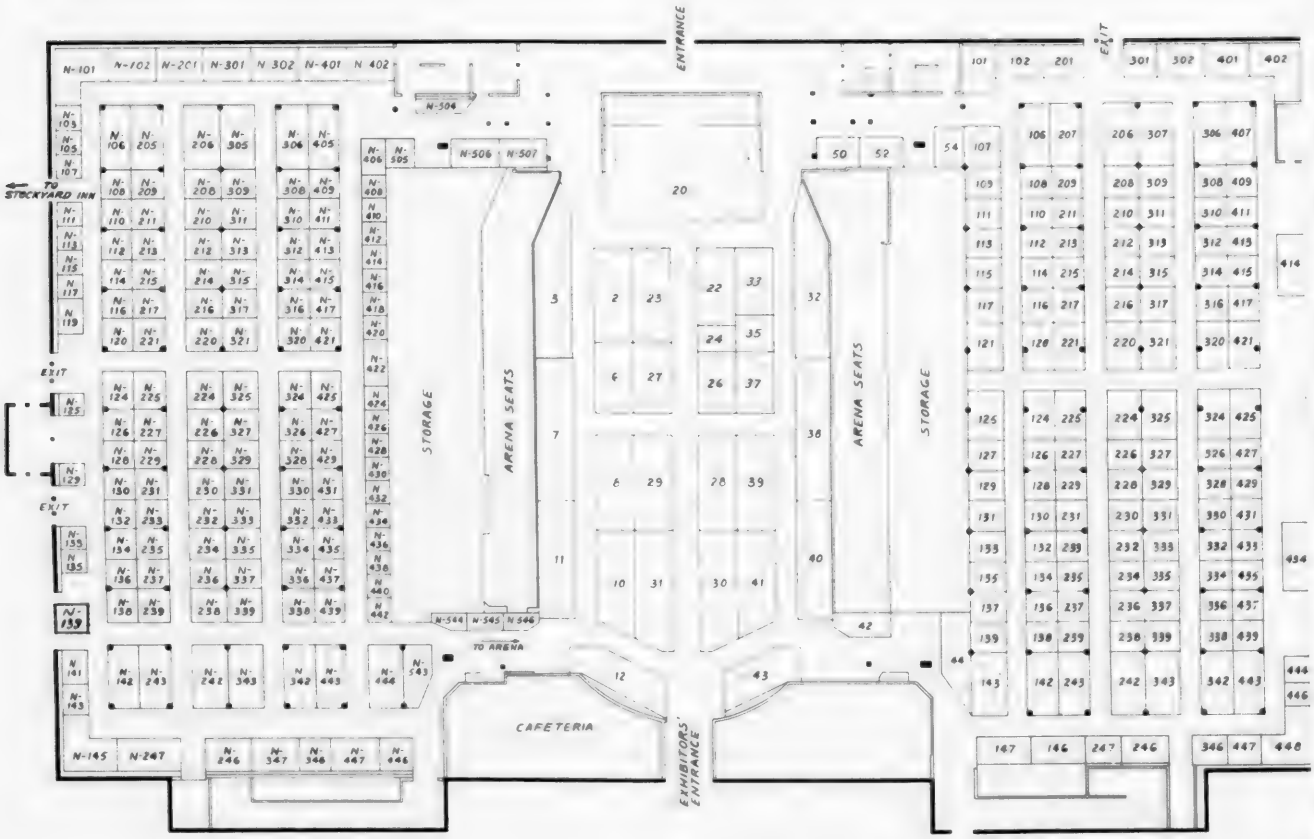
6 Armstrong Furnace Co., Div., National Union Electric Corp., Columbus, Ohio

625 Armstrong Machine Works, Three Rivers, Mich.
627

625 Armstrong Steam Trap Co., Three Rivers, Mich.
627

663 Arrow-Hart & Hegeman Electric Co., The, Hartford, Conn.
665

N-230 Arvin Industries, Inc., Columbus,



Arrangement of exhibit booths and booth numbers, International Heating

N-232 Ind.

N-440 Ascot Gas Water Heaters, Inc., Milwaukee, Wis.

N-126 Associated Laboratories, Inc., Lathrup Village, Mich.

1009 Auer Register Co., The, Cleveland, Ohio

568 Aurora Pump Div., The New York Air Brake Co., Aurora, Ill.

425 Au-Temp-Co Corp., Div., Heat-Timer Corp., New York, N. Y.

302 401 Auto-Flo Corp., Detroit, Mich.

N-504 Automatic Devices Div., American Machine and Metals, Inc., Western Springs, Ill.

N-129 Automatic Humidifier Div., Standard Manufacturing Co., Cedar Falls, Iowa

N-337 Avon Tube Div., Higbie Mfg. Co., Rochester, Mich.

765 767 Aluminum Co. of America, New Kensington, Pa.

1024 Bacharach Industrial Instrument Co., Pittsburgh, Pa.

39 Baltimore Aircoil Co., Inc., Baltimore, Md.

506 508 Barber-Colman Company, Air Distribution Products Div., Automatic Controls Div., Rockford, Ill.

446 Barke Products Inc., Bay Village, Ohio

1111 Barnebey-Cheney Co., Columbus, Ohio

720 Barry Blower Co., Minneapolis, Minn.

851 Baso, Inc., Milwaukee, Wis.

N-342 Bastian-Morley Co., Inc., La Porte, Ind.

1104 Bayley Blower Co., Div., The Green Fuel Economizer Co. Inc., Milwaukee, Mis.

911 Bell & Gossett Co., Morton Grove, Ill.

309 311 Bendix-Westinghouse Automotive Air Brake Co., Evansville, Ind.

1062 1064 Binke Manufacturing Co., Chicago, Ill.

N-335 Bloomer Cooling Tower Div., Fiske Co., Chicago, Ill.

606 Bohn Aluminum & Brass Corp., Danville Div., Danville, Ill.

N-117 Boiler Equipment Trust Co., Amherst, Mass.

232 Bootz Mfg. Co., Inc., Evansville, Ind.

745 Boyle Engineering Laboratory, Chicago, Ill.

763 Brandes Co., Madison, Wis.

N-229 Breidert Co., The G. C., San Fernando, Calif.

52 Brookside Corp., McCordsville, Ind.

729 Brown Products Corp., A., Union, N. J.

607 Browning Mfg. Co., Maysville, Ky.

609 611 Brundage Co., The, Kalamazoo, Mich.

N-138 Bryan Steam Corp., Peru, Ind.

N-444 Buensod-Stacey Corp., New York, N. Y.

832 933 Buffalo Forge Co., Buffalo, N. Y.

313 315 Burgess-Manning Co., Architectural Products Div., Libertyville, Ill.

N-143 Burke & Co., Los Angeles, Calif.

Burnham Corp., Irvington, N. Y.
714 Heating & Cooling Div.

708 710 Steel Boiler Dept.

706 708 Warm Air & Cooling Div., Belle Vernon, Pa.

1124 1126 Byers Company, A. M., Pittsburgh, Pa.

524 Caterpillar Tractor Co., Peoria, Ill.

327 CRS Industries, Inc., Philadelphia, Pa.

755 Calgon Co., Div., Hagan Chemicals & Controls, Inc., Pittsburgh, Pa.

914 Cambridge Filter Corp., Syracuse, N. Y.

N-243 Cargocaire Engineering Corp., New York, N. Y.

940 Carnes Corp., Verona, Wis.

549 569 Carrier Air Conditioning Co., Syracuse, N. Y.

707 Cash Valve Mfg. Corp., A. W., Decatur, Ill.

915 Century Electric Co., St. Louis, Mo.

962 Century Engineering Corp., Cedar Rapids, Iowa

1030 Chace Company, W. M., Detroit, Mich.

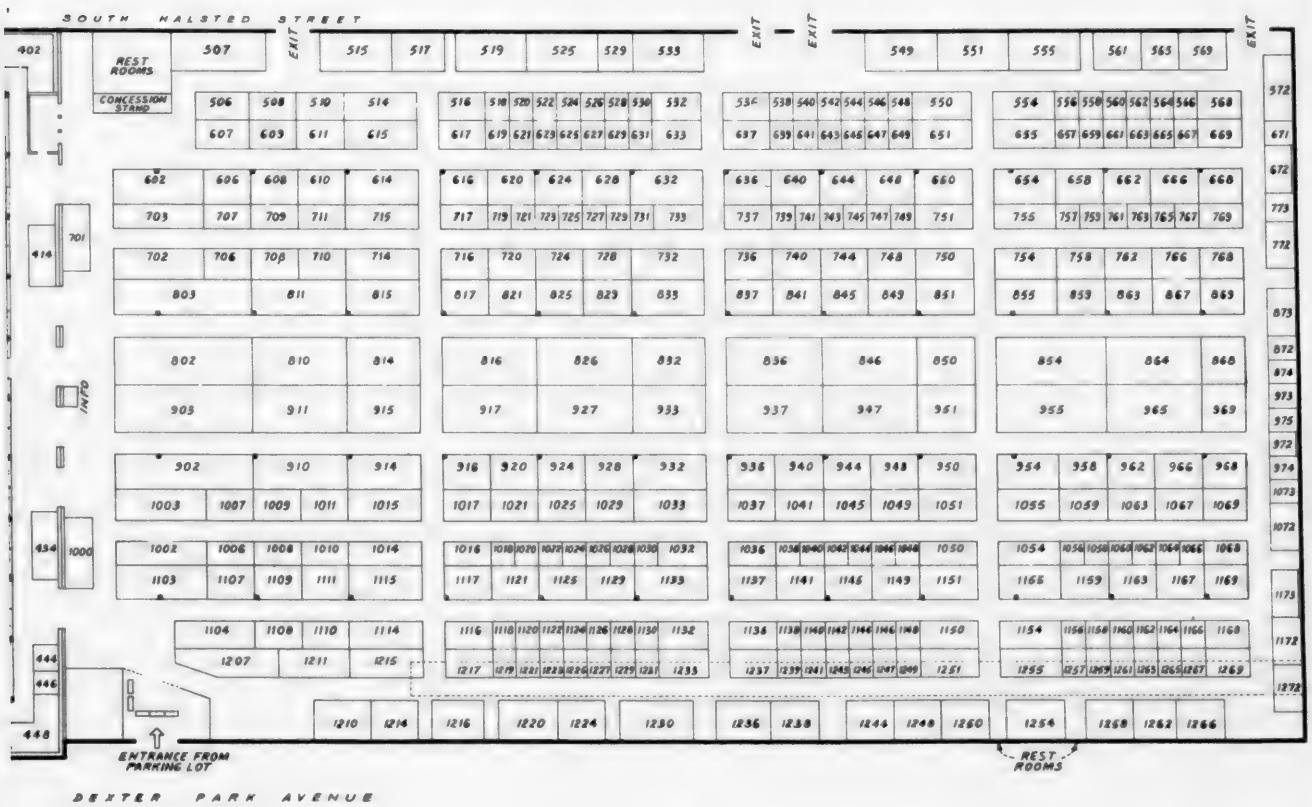
651 Champion Blower & Forge Co. Inc., Lancaster, Pa.

N-415 Chatleff Controls, Inc., Austin, Tex.

602 703 Chicago Blower Corp., Franklin Park, Ill.

31 Chicago Pump, Hydrodynamics Div., Food Mchry. & Chemical Corp., Chicago, Ill.

649 Chicago Steel Furnace Co., Elk Grove, Ill.



and Air Conditioning Exposition, International Amphitheater, Chicago

810 Clarage Fan Co., Kalamazoo, Mich.

334 Clayton Mark & Co., Evanston, Ill.

33 Cleaver-Brooks Co., Milwaukee, Wis.

1221 Cleveland Controls, Inc., Cleveland, Ohio

1026 Cobra Metal Hose Div., D. K. 1028 Mfg. Co., Chicago, Ill.

1245 Coleman Co., Inc., The, Wichita, 1247 Kan.
1249

N-347 Collins Machinery Corp., Monterey Park, Calif.

655 Columbia Boiler Co. of Pottstown, Pottstown, Pa.

12 Combustion Control Div., Electronics Corp. of America, Cambridge, Mass.

411 Commercial Filters Corp., Melrose, Mass.

N-421 Combustion Engineering Corp., Chicago, Ill.

142 Connor Engineering Corp., Shelter Rock Lane, Danbury, Conn.

1033 Continental Air Filters, Inc., Louisville, Ky.

N-443 Continental Automatic Boiler Div., Boiler Engineering & Supply Co. Inc., Phoenixville, Pa.

1173 Continental Manufacturing Co., Baltimore, Md.

803 Controls Company of America, Heating & Air Conditioning Div., Milwaukee, Wis.

644 Cook Co., Loren, Berea, Ohio

N-242 Cool Heat Div., Drying Systems Co., Chicago, Ill.

335 Coolerator Div., McGraw-Edison 337 Co., Albion, Mich.

515 Copeland Refrigeration Corp., 517 Sidney, Ohio

825 Crane Co., Plumbing, Heating, 826 Air Conditioning Group, Johns- 829 town, Pa.
924
927
928

850 Curtis Mfg. Co., Refrigeration 951 Div., St. Louis, Mo.

1155 Cutler-Hammer, Inc., Milwaukee, Wis.

135 Danfoss, Inc., Lodi, N. J.
137
139

N-124 Dekoron Products Div., Samuel Moore & Co., Mantua, Ohio

1021 Delavan Mfg. Co., West Des Moines, Iowa

N-330 Delco Appliance Div., General N-332 Motors Corp., Rochester, N. Y.

N-145 Delco Products Div., General Motors Corp., Dayton, Ohio

N-433 Diehl Mfg. Co., Somerville, N. J.

572 Doerr Electric Corp., Cedarburg, Wis.

328 Dole Refrigerating Co., Chicago, Ill.

N-111 Dongan Electric Mfg. Co., Detroit, Mich.

N-239 Dornback Furnace and Foundry Co., Eastlake, Ohio

N-239 Dornback Industries, Eastlake, Ohio

1258 Dravo Corp., Pittsburgh, Pa.
1262

1172 Drayer-Hanson Div., Hi-Press Air Conditioning of America, Inc., Los Angeles, Calif.

107 Dryer Dynamics Corp., Lyndhurst, N. J.

210 Dryomatic Corp., Alexandria, Va.

32 Dunham-Bush, Inc., West Hartford, Conn.

1211 duPont de Nemours & Co., E. I., Freon Products Div., Wilmington, Del.

243 Dura-Vent Corp., Louisville, Ky.

772 Duro-Dyne Corp., Farmingdale, 773 N. Y.

1016 Dwyer Mfg. Co., F. W., Michigan City, Ind.

N-224 Dynatherm Div., Bethlehem Foun- N-226 dry & Machine Co., Bethlehem, Pa.

1266 Econo Products Co., Inc., East Haddam, Conn.

624 Edwards Engineering Corp., 628 Pompton Plains, N. J.

132 Electric Boat Div., General Dy- 134 namics Corp., Groton, Conn.

815 Electro-Air Cleaner Co., McKees Rocks, Pa.

136 Electro Dynamic Div., General Dynamics Corp., Bayonne, N. J.

413 Electromode Div., Commercial 415 Controls Corp., Rochester, N. Y.

645 Elgen Mfg. Corp., Long Island 647 City, N. Y.

542 Emerson Electric Mfg. Co., The, 548 St. Louis, Mo.

101 Engel Sheet Metal Equipment, 102 St. Louis, Mo.
201 Inc.

N-324 Excelsior Steel Furnace Co., The, Chicago, Ill.

213 Fairbanks, Morse & Co., Chicago, 215 Ill.

10 Farr Co., El Segundo, Calif.

737 Fasco Industries, Inc., Rochester, N. Y.

702 Feddera Corp., Trenton Div., Trenton, N. J.

11 Federal Boiler Co. Inc., Midland Park, N. J.

717 Fee & Mason Mfg. Co., Inc., Manasquan, N. J.

N-505 Felter Co., John, Houston, Texas

732 Field Control Div., Conco Engineering Works, Inc., Mendota, Ill.

536 Flanders Filters, Inc., Riverhead, N. Y.

320 Flexible Tubing Corp., Guildford, Conn.

538 Flexonics Corp., Subsidiary of 540 Calumet & Hecla, Inc., Maywood, Ill.

869 Fram Aire Corp., Fram Corp., Providence, R. I.

1115 Frick Co., Waynesboro, Pa.

228 Fulton Sylphon Div., Robertshaw- 230 Fulton Controls Co., Knoxville, Tenn.

1146 Furhas Electric Co., Batavia, Ill.
1148

562 Gallaher Company, The, Omaha, 564 Nebr.

754 General Air Products Corp., Stirling, N. J.

121 General Automatic Products Corp., Baltimore, Md.

1045 General Blower Co., Morton Grove, Ill.

43 General Chemical Div., Allied Chemical Corp., New York, N. Y.

814 General Controls Co., Glendale, Calif.

736 General Electric Co., Apparatus 744 Sales Division, Schenectady, N.Y.

762 General Filters, Inc., Novi, Mich.

414 General Heating Products Co.; Philadelphia, Pa.

N-338 General Products Co., Inc., Fredericksburg, Va.

N-246 General Thermo Electric Corp., Monmouth Junction, N. J.

1269 Goodfellow Co., Inc., E. D., Memphis, Tenn.

N-543 Gordon & Piatt, Inc., Winfield, Kansas

507 Governair Corp., Oklahoma City, Okla.

228 Grayson Controls Div., Robert- 230 shaw-Fulton Controls Co., Long Beach, Calif.

310 Greenbeck Fan & Ventilator Corp., Schofield, Wis.

N-325 Gregory Industries, Inc., Lorain, N-327 Ohio

N-334 Gulf Oil Corp., Pittsburgh, Pa.
N-336

50 Gustin-Bacon Mfg. Co., Kansas City, Mo.

1238 H. & H. Tube Mfg. Co., Detroit, Mich.

N-217 Halstead & Mitchell, Pittsburgh, Pa.

747 Hammond Valve Corp., Hammond, Ind.

721 Harris & Co., Arthur, Chicago, Ill.

1136 Hart & Cooley Mfg. Co., Holland, Mich.

863 Hastings Air Control, Inc., 867 Omaha, Nebr.

1129 Hays Mfg. Co., Automatic Controls Div., Erie, Pa.

629 Heat Controller, Inc., Jackson, 631 Mich.

425 Heat-Timer Corp., New York, N. Y.

N-442 Heil Process Equipment Corp., Cleveland, Ohio

129 Heil-Quaker Corp., Nashville, 131 Tenn.

30 Henry Furnace Co., The, Medina, 41 Ohio

1217 Henry Valve Co., 3215 North 1219 Ave., Melrose Park, Ill.

N-346 Hercules Chemical Co., Inc., New York, N. Y.

127 Herrmidifier Co., Lancaster, Pa.

972 Highside Chemicals, Inc., Clifton, 974 N. J.

N-418 Hild Floor Machine Co. Inc., Chicago, Ill.

N-431 Hilti, Inc., Stamford, Conn.

1160 Howell Electric Motors Co., 1162 Howell, Mich.
1164

711 Hubbell Corp., Mundelein, Ill.

667 Hydrodynamics Div., Hydrotherm, 669 Inc., Northvale, N. J.

1037 Ilg Electric Ventilating Co., Chi- 1041 cago, Ill.

40 Illinois Engineering Div., American Air Filter Co., Inc., Chicago, Ill.

306 Illinois Iron & Bolt Co.; Freeman Heating Div.; Automatic Solid Fuels Div., Carpentersville, Ill.

N-228 Imperial Brass Mfg. Co., The, Chicago, Ill.

N-328 Imperial Damper Co., New York, N. Y.

739 Independent Register Co., Inc., Cleveland, Ohio

1103 Industrial Acoustics Co., Inc., New York, N. Y.

28 Industrial Combustion, Inc., Milwaukee, Wis.

N-438 Industrial Engineering Equipment Co., St. Louis, Mo.

116 Industrial Plastic Fabricators Inc., Norwood, Mass.

751 Industrial Press, New York, N. Y.

659 661 Ingersoll-Rand Co., New York, N. Y.

1022 Insto-Gas Corp., Detroit, Mich.

811 International Heater Co., Utica, N. Y.

950 1108 Iron Fireman Mfg. Co., Cleveland, Ohio

727 Isoflex Sales Co., Burlingame, Calif.

209 211 Isotron Div., Pennsalt Chemicals Corp., Philadelphia, Pa.

N-227 Jackes-Evans Mfg. Co., St. Louis, Mo.

519 533 Janitrol Heating & Air Conditioning Div., Midland-Ross Corp., Columbus, Ohio

1230 Jenkins Bros., New York, N. Y.

833 Jenn Air Products Co., Inc., Indianapolis, Ind.

N-313 Jet-Heet, Inc., Englewood, N. J.

447 448 Johns-Manville Sales Corp., New York, N. Y.

N-405 Johnson Furnace Co., The, Cleveland, Ohio

321 Johnson Heater Corp., Chelsea, Mass.

N-446 N-447 Johnson Co., S. T., Brideport, Pa.

836 937 Johnson Service Co., Milwaukee, Wis.

402 Johnston Brothers, Inc., Ferryburg, Mich.

N-343 K S M Products, Inc., Moorestown, N. J.

1128 Kaiser Aluminum & Chemical Corp., Oakland, Calif.

1236 Kenmore Machine Products, Inc., Lyons, N. Y.

40 Kennard Div., American Air Filter Co., Inc., St. Louis, Mo.

N-326 Kimberly-Stevens Corp., New York, N. Y.

1160 1162 1164 Kingston-Conley, Inc., Plainfield, N. J.

242 Koppers Co., Inc., Metal Products Div., Baltimore, Md.

42 Korfund Co., Inc., The, Westerbury, N. Y.

143 Koven & Brothers, Inc., L. O., Dover, N. J.

1137 Kritzer Products Div., Peerless of America, Inc., Chicago, Ill.

312 314 316 Krueger Air Conditioning Co., Tucson, Ariz.

N-333 Kresno-Stamm Mfg. Co., Palisades Park, N. J.

237 239 Lake Chemical Co., Chicago, Ill.

326 Larkin Coils, Inc., Atlanta, Ga.

910 Lau Blower Co., The, Dayton, Ohio

212 Laurel Products Co., River Falls, Wis.

719 Lawler Automatic Controls, Inc., Mt. Vernon, N. Y.

N-231 Leece-Neville Co., Georgia Div., Gainesville, Ga.

1239 1241 Lehigh Fan & Blower Div., Fuller Co., Catasauqua, Pa.

1160 1162 1164 Leland Ohio Electric Co., Dayton, Ohio

N-206 N-216 N-305 Lennox Industries, Inc., Marshalltown, Iowa

1166 Lennox Tool and Machine Builders, Lima, Ohio

N-544 Leslie Welding Co., Inc., Franklin Park, Ill.

434 Lewin-Mathes Co., Div., Cerro Corp., St. Louis, Mo.

N-133 Liberty Combustion Corp., Syracuse, N. Y.

1168 Lima Register Co., Lima, Ohio

N-342 Little Burner Co., H. C., La Porte, Ind.

837 Lockformer Co., The, Chicago, Ill.

1000 McDonnell & Miller, Inc., Chicago, Ill.

317 McIntire Co., The, Livingston, N. J.

N-135 McLarty Systems, Battle Creek, Mich.

802 McQuay, Inc., Minneapolis, Minn.

N-316 McQuay-Norris Mfg. Co., St. Louis, Mo.

1036 Magnetrol, Inc., Downers Grove, Ill.

346 Maid-O'-Mist, Inc., Chicago, Ill.

1118 Major Controls Co., Corona, Calif.

N-221 Mamco Corp., Racine, Wis.

917 Mammoth Industries, Inc., Minneapolis, Minn.

N-142 Maplewood Div., Rockford Machine Tool Co., Rockford, Ill.

1151 Marathon Electric Mfg. Corp., Wausau, Wis.

237 239 Markal Co., Chicago, Ill.

616 620 Marley Co., The, Kansas City, Mo.

1215 Marlo Coil Co., St. Louis, Mo.

639 641 643 Marsh Instrument Co., Div., Colorado Oil and Gas Corp., Skokie, Ill.

N-436 Mastercraft Industries, Inc., Garfield, N. J.

916 920 Maxitrol Co., Southfield, Mich.

N-328 Mechanical Contractors Supply Co. Inc., New York, N. Y.

44 Maier Electric & Machine Co., Inc., Indianapolis, Ind.

35 Mercoid Corp., The, Chicago, Ill.

409 Metalbestos Div., William Wallace Co., Belmont, Calif.

1116 Mid-Continent Metal Products Co., Chicago, Ill.

1158 Milwaukee Electric Tool Corp., Milwaukee, Wis.

227 Milwaukee Valve Co., Milwaukee, Wis.

147 Mine Safety Appliances Co., Pittsburgh, Pa.

965 969 Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

N-420 Mipatan Div., Port City Machine & Tool Co., Muskegon, Mich.

1048 Mission Valve & Pump Co. Div., Mission Mfg. Co., Houston, Tex.

741 743 Modern Flo-Trol Products Corp., Babylon, N. Y.

632 Modine Mfg. Co., Racine, Wis.

1050 Monarch Mfg. Works, Inc., Philadelphia, Pa.

146 Monogram Industries, Inc., Quincy, Ill.

554 Morrison Products, Inc., Cleveland, Ohio

N-235 Mt. Hawley Mfg. Co., Peoria, Ill.

845 849 Mueller Brass Co., Port Huron, Mich.

1055 1059 Mueller Climatrol Div., Worthington Corp., Milwaukee, Wis.

566 Multi-Vent Div., The Pyle National Co., Chicago, Ill.

1250 National Heater Co., Inc., St. Paul, Minn.

N-246 Needco Group of Companies, Princeton, N. J.

40 Nelson Div., Herman, American Air Filter Co., Inc., Louisville, Ky.

816 New York Blower Co., The, Chicago, Ill.

N-506 Niagara Furnace Div., The Forest City Foundries Co., Cleveland, Ohio

817 821 Niagara Machine & Tool Works, Buffalo, N. Y.

114 NRC Equipment Corp., Newton, Mass.

N-432 Octagon Ventilator Mfg. Co., Jackson, Tenn.

1160 1162 1164 Ohio Electric Mfg. Co., Maple Heights, Ohio

N-417 Oil Equipment Mfg. Corp., New Haven, Conn.

30, 41 Olsen Mfg. Co., The C. A., Elyria, Ohio

108 110 Clark Industries, Inc., Portland, Ore.

207 Orr & Sembower, Inc., Reading, Pa.

1233 Oster Mfg. Co., The, Wickliffe, Ohio

654 Owens-Corning Fiberglas Corp., Toledo, Ohio

1223 1225 Panelbloc Div., Betcher Mfg. Co., Cleveland, Ohio

757 Paragon Electric Co., Two Rivers, Wis.

N-225 Parker Boiler Mfg. Co. Inc., Los Angeles, Calif.

1141 Peerless of America, Inc., Chicago, Ill.

8 Peerless Corp., The, Indianapolis, Ind.

206 Peerless Electric Div., H. K. Porter Co., Inc., Warren, Ohio

1072 1073 Peerless Heater Co., The, Boyertown, Pa.

243 Peerless Mfg. Div., Dover Corp., Louisville, Ky.

1272 Peerless Pump, Hydrodynamics Div., Food Machinery and Chemical Corp., Los Angeles, Calif.

N-426 Pelna Engineering Corp., Philadelphia, Pa.

N-234 N-236 N-238 Penn Controls, Inc., Goshen, Ind.

338 Penn Ventilator Co. Inc., Philadelphia, Pa.

128 130 Pennsylvania Furnace & Iron Co., Warren, Pa.

1002 Perfection Div., Hupp Corp., Cleveland, Ohio

N-141 Permalife Glass Fiber Div., Standard Electric Co., San Antonio, Texas

518 Perolin Co., Inc., The, Chicago, Ill.

325 Petro, Cleveland, Ohio

N-114 Pioneer Products Div., Witco

Chemical Co., Inc., New York, N. Y.

N-128 Pittsburgh Corning Corp., Pittsburgh, Pa.

125 Pittsburgh Plate Glass Co., Fiber Glass Div., Pittsburgh, Pa.

112 Plan Hold Corp., South Gate, Calif.

1120 Power Flame Div., Inc., Siemom, Co., Grandview, Mo.
1122

637 Power Line Fan Co., Div., Chelsea Products, Inc., Plainfield, N. J.

872 Powers Regulator Co., The, Skokie, Ill.
873

117 Purolator Products, Inc., Rahway, N. J.

443 Quickdraft Corp., The, Canton, Ohio

1156 R-B-M Controls Div., Esses Wire Corp., Logansport, Ind.

214 Radio Central Co., Northbrook, Ill.

417 Radio Corp. of America, Camden, N. J.

855 Ranco Inc., Columbus, Ohio

1007 Randall Graphite Bearings, Inc., Lima, Ohio

N-425 Raypak Co., Inc., El Monte, Calif.

633 Ready Power Co., The, Detroit, Mich.

216 Ree-Unit Fans, Inc., New Orleans, La.

N-306 Refrigeration Research, Brighton, Mich.

414 Republic Products Co., Philadelphia, Pa.

1017 Research Products Corp., Madison, Wis.

1068 Revcor, Inc., Carpentersville, Ill.

662 Rheem Mfg. Co., Chicago, Ill.
666

516 Ric-wil, Inc., Barberton, Ohio

636 Ridge Tool Co., The, Elyria, Ohio
640

1231 Roberts-Gordon Appliance Corp., Buffalo, N. Y.

228 Robertshaw-Fulton Controls Co.,
230 Richmond, Va.
Fulton Sylphon Div., Knoxville, Tenn.
Grayson Controls Div., Long Beach, Calif.

301 Robertson Co., H. H., Pittsburgh, Pa.

N-233 Robinaire Mfg. Corp., Montpelier, Ohio

745 Rotherm Engineering Co., Inc., Chicago, Ill.

N-437 Royal Mfg. Co., Royal Oak, Mich.
N-209 Rubatex Div., Great American Industries, Inc., Bedford, Va.

229 Ray Oil Burner Co., San Fran-
231 cisco, Calif.

N-125 S.O.S. Products Co., Inc., Brooklyn, N. Y.

N-107 Safe-Guard Corp., Lansdale, Pa.

615 Sarco Co., Inc., New York, N. Y.

615 Sarcotherm Controls, Inc., New York, N. Y.

1263 Schemenauer Mfg. Co., Holland,
1265 Ohio
1267

975 Schnake, Inc., Evansville, Ind.

417 Scully Signal Co., Melrose, Mass.

N-237 Seaboard Products Corp., Newark, N. J.

N-545 Senna Mfg. Co., Spokane, Wash.

N-113 Shaw-Perkins Co., Pittsburgh, Pa.
N-115

N-412 Shenango Refractories, New Castle, Pa.

N-428 Silvercote Products, Inc., Chicago, Ill.

668 Skuttle Mfg. Co., Milford, Mich.

435 Slant Fin Radiator Corp., Rich-
437 mond Hill, N. Y.
439

1130 Smith Corp., A. O., Milwaukee,
1132 Wis.

522 Smith Corp., A. O., Kankakee, Ill.

614 Smith Co., Inc., The H. B. Westfield, Mass.

608 Southwest Mfg. Co., Aurora, Mo.
610

308 Spartan Convector Co., Inc., Maspeth, N. Y.

N-205 Spiro U.S.A., Inc., Chicago, Ill.

1254 Sporlan Valve Co., St. Louis, Mo.

1227 Sprague Electric Co., North
1229 Adams, Mass.

758 Spraying Systems Co., Bellwood, Ill.

510 Square D Co., Milwaukee, Wis.

307 Standard Refrigeration Co., Chicago, Ill.

1054 Standard Stamping & Perforating Co., Chicago, Ill.

N-435 Stanley Electric Tools Div., The Stanley Works, New Britain, Conn.

208 Star Expansion Industries Corp., Mountainville, N. Y.

1244 Steinen Mfg. Co., Wm., Newark, N. J.
Heating Products Div.
Industrial Nozzle Div.

133 Sealmaster Div., Stephens-Adam-
1251 son Mfg. Co., Aurora, Ill.

1150 Stewart-Warner Corp., Heating & Air Conditioning Div., Lebanon, Ind.

427 Stoddard Industries, Inc., Cudahy, Wis.

748 Strong, Carlisle & Hammond, Conneaut, Ohio

617 Sundstrand Hydraulics Div.,
619 Sundstrand Corp., Rockford, Ill.

715 Sun-Ray Burner Manufacturing Corp., Jamaica, N. Y.

1014 Swartout Fabricators Inc., Kokomo, Ind.

N-103 Synchronous Flame, Inc., Wal-
N-105 worth, Wis.

336 Stokermatic Co., Salt Lake City, Utah

1011 Taco Heaters, Inc., Cranston, R.I.

N-427 Tann Corp., Congress Drives Div.
Tann Bearing Div., Detroit, Mich.

339 Tecumseh Products Co., Tecum-
343 seh, Mich.

444 Televance Corp., St. Louis, Mo.

621 Temco, Inc., Nashville, Tenn.
623

1025 Thatcher Furnace Co. Garwood,
1029 N. J.

944 Thermac Co., Corona, Calif.

124 Thermal Engineering Corp.,
225 Houston, Texas

N-429 Thermo - Pak Boilers, Inc., Alhambra, Calif.

N-220 Thermo - Products, Inc., North Judson, Ind.

761 Thermotank, Inc., Air Products Div., Detroit, Mich.

N-119 Thermo-Wheel, Inc., Long Island City, L. I.

733 Thrush & Company, H. A., Peru, Ind.

902 Titus Mfg. Corp., Waterloo, Iowa

N-211 Tjernlund Mfg. Co., St. Paul,
N-213 Minn.
N-215

233 Toledo Pipe Threading Machine Co., Toledo, Ohio

724 Torridheet Div., Cleveland Steel
728 Products Corp., Cleveland, Ohio

947 Torrington Mfg. Co., The, Torrington, Conn.

3 Trane Co., The, LaCrosse, Wis.
7

N-408 Trerice Co., H.O., Detroit, Mich.
N-410

N-505 Triangle Engineering Co., Houston, Texas

1255 Trico Drilling Div., Wheel Truing Tool Co., Detroit, Mich.

N-507 Trion, Inc., McKees Rocks, Pa.

126 Triplex Heating Specialty Co., Inc., Peru, Ind.

768 Tuttle & Bailey Div., Allied Thermal Corp., New Britain, Conn.

N-339 Tuttle Electric Products, Inc., Kirkland, Ill.

671 Tuttle & Co., H. W., Tecumseh, Mich.

234 Typhoon Air Conditioning Div.,
236 Hupp Corp., Brooklyn, N. Y.
238

948 Union Carbide Development Co., Union Carbide Corp., New York, N. Y.

N-136 Union Damper Co., Union, Ill.

874 United Sheet Metal Co., Inc.,
973 Columbus, Ohio

648 United States Air Conditioning Corp., Delaware, Ohio

N-120 United States Gypsum Co., Chicago, Ill.

1032 United States Register Co., Battle Creek, Mich.

1149 Universal Diffuser Corp., Tuckahoe, N. Y.

N-116 Van Dorn Iron Works Co., The, Infra Red Div., Cleveland, Ohio

N-424 Van-Packer Co., Div., The Flintkote Co., Chicago Heights, Ill.

331 Vapor Heating Corp., Chicago, Ill.

421 Ventfabrics, Inc., Chicago, Ill.

226 Vernco Corp., Columbus, Ind.

1259 Vibration Eliminator Co., The, Long Island City, N. Y.

658 Vibration Mountings, Inc., Corona, N. Y.

N-409 Viking Air Products Div., The
N-411 Lau Blower Co., Cleveland, Ohio

329 Vilter Mfg. Company, The, Milwaukee 7, Wis.

846 Vulcan Radiator Co., Hartford, Conn.

N-413 W-M Mfg. Co., Chicago, Ill.

1109 Wagner Electric Corp., St. Louis, Mo.

N-308 Walker Mfg. & Sales Corp., St.
N-310 Joseph, Mo.

37 Walton Laboratories, Inc., Irvington, N. J.

N-309 Walworth Co., New York, N. Y.

1243 Warren Engineering Co., Div., Warren Automatic Controls Corp., Broadway, N. J.

29 Waterloo Register Company, Inc., Waterloo, Iowa

324 Waterman-Waterbury Co., Minneapolis, Minn.

224 Watts Regulator Co., Lawrence, Mass.

1125 Waukesha Motor Co., Waukesha, Wis.

769 Weatherhead Co., The, Fort Wayne Div., Fort Wayne, Ind.

1107 Webster Electric Co., Racine, Wis.

1138 1144 Warren Webster & Co., Inc., Camden, N. J.

903 Weil-McLain Co., Michigan City, Ind.

954 958 Weil Pump Co., Chicago, Ill.

N-106 Welty-Way Products, Inc., Cedar Rapids, Iowa

229 231 Western Boiler Co., San Francisco, Calif.

138 Western Supply Co., Hutchinson, Kans.

955 Westinghouse Electric Corp., Air Conditioning Div., Staunton, Va.

2 Motors & Control, Buffalo, N.Y.

1117 1121 White-Rodgers Co., St. Louis, Mo.

1237 Wiegand Company, Edwin L., Pittsburgh, Pa.

N-329 N-331 Will-Burt Co., The, Orrville, Ohio

550 Williams Oil-O-Matic Heating Co. Div., National Union Electric Corp., Columbus, Ohio

109 115 Williamson Co., The, Cincinnati, Ohio

1003 Wing Mfg. Co., L. J. Div., Aero Supply Mfg. Co. Inc., Linden, N. J.

N-439 Wiremold Co., The, Hartford, Conn.

1154 Wolverine Tube Div., Calumet & Hecla, Inc., Allen Park, Mich.

221 Worley Equipment, Inc., Chicago, Ill.

1063 1067 1069 Worthington Corp., Harrison, N. J.

750 Welbilt Air Conditioning & Heating Co., Farmingdale, N. J.

220 Winchester-Western Div., Olin Mathieson Chemical Corp., New Haven, Conn.

1006 XXth Century Heating & Ventilating Co., Akron, Ohio

N-406 Yeats Appliance Dolly Sales Co., Milwaukee, Wis.

1210 1224 York Corp., York, Pa.

York-Shipley, Inc., York, Pa.
N-301 General Div.
N-101 Industrial Div.
N-102
N-201
N-401 I. & C. Div.
N-402
N-302 Residential Div.

514 Young Radiator Co., Racine, Wis.

716 Young Regulator Co., Cleveland, Ohio

330 332 431 433 Yuba Consolidated Industries, Inc., San Francisco, Calif.

New Type Bank Building Serves San Francisco

Over thirteen miles of duct work are contained in the new 8-story building of the Bank of America in San Francisco, Calif. The building was so designed that it can be expanded to 13 stories. It will house what is believed to be the greatest assembly of banking equipment assembled in one building. A large amount of electronic equipment is used including a data processing center. Double floor and ceiling construction is used to provide space for running electrical lines and duct work.

An ERMA center, consisting of electronic units, does the computations for striking customers' balances, sorting checks and deposit slips and it maintains printed records required by the bank branch and customer for checking account bookkeeping.

The large amount of electronic equipment requires rigid temperature and humidity control. The air conditioning mechanical equipment is located on the sixth floor to minimize the size of vertical ducts and to free basement and ground floors for banking use. The main installation consists of two 550-ton chilling machines —one to serve the north half of the building and the other the south half.

Four main fans, mounted in paids, have 6 ft squirrel cage wheels. Fan bases are 18.5-ton concrete slabs which float on spring type vibration isolators. Air is cleaned by a 50 x 17 ft panel of changeable filters.

The basement and ground floors are served by conventional ventilating equipment installed in the basement to handle 78,000 cfm. A special exhaust system eliminates fumes from automobiles in the basement from entering the ground floor and mezzanine.

A remote control panel on the sixth floor controls all the air conditioning units. A similar panel in the basement controls the operation of the basement and ground floor systems. By pushing buttons, the operator can read temperature at points inside and outside the building, and can start and operate all of his units.

Recently completed Bank of America building, San Francisco.

One of the four main blowers for the air conditioning system.

Good Air Distribution Through Perforated Ceilings

Pertinent design data are presented for the commonly used ceiling materials, some application details are covered, and help given in duct design.

MAURICE J. WILSON
Market Promotion Specialist, Unitary Equipment Div., Carrier Corp., Syracuse, N. Y.

AIR CONDITIONED areas having average sensible heat loads can well be served by "all-air" type systems in which the treated air is introduced to the conditioned space through a perforated ceiling. This type of air diffusion has proven very satisfactory and has been used for the interior spaces of office buildings, the public areas of banks, auditoriums and lobbies. Aside from functional advantages, there is a definite economic appeal when the perforated type acoustical ceilings are used.

Today engineers are giving considerable thought to the use of various types of perforated ceilings for the introduction of conditioned air for both comfort and industrial applications. The advantage of this method of air diffusion is the fact that a greater volume of air per square foot of floor area may be introduced at lower temperatures with a minimum of movement in the breathing zone, and therefore with less danger of a draft. A number of installations of various types now in operation indicate that the advantages of this method can be realized if proper application precautions are taken.

J. M. Sanacoustic Ceiling

This ceiling is made of No. 26 U. S. gage sheet metal, with approximately 4608 holes per square foot; each hole is 0.068 inch in diameter. This means 11.6% of the ceiling area is perforated, if the entire ceiling is provided with perforated metal. Each tile is 12 x 24 inches and the unit is scored to give a ceiling pattern 12 inches square. These units are also available without perforations and unscored. Thus, by using plain panels any desired percentage of the total ceiling in perforations may be obtained.

Each individual unit snaps into position on a network of tee bars which are hung below the floor slaps to form a plenum space above the suspended ceiling. Removal of a unit permits servicing and adjustment of dampers, valves, and other equipment which may be installed in the plenum space. Acoustical material, when used, may be applied to the underside of the floor slab. The heat gained from an unconditioned floor above, is thereby reduced and in this manner accessibility to the plenum space is maintained.

Celotex Ceiling

This unit consists of one inch thick Celotex, 24 x 24 inches, with 529 holes, ⅜ inch in diameter. Plain unperforated panels may be combined with perforated units to obtain the desired hole opening and adequate air velocity through the holes.

Also available from this manufacturer are perforated asbestos panels of ⅜ inch or ¼ inch thickness with smooth finish and with openings ¼ inch diameter or smaller, with proper spacing to provide free areas of approximately 11% of the ceiling area.

Hauserman Ceiling

These units are similar to the J. M. pans but are made with 20 gage metal with 729 holes, 0.093 inch in diam per sq ft. The free opening is about 3½%.

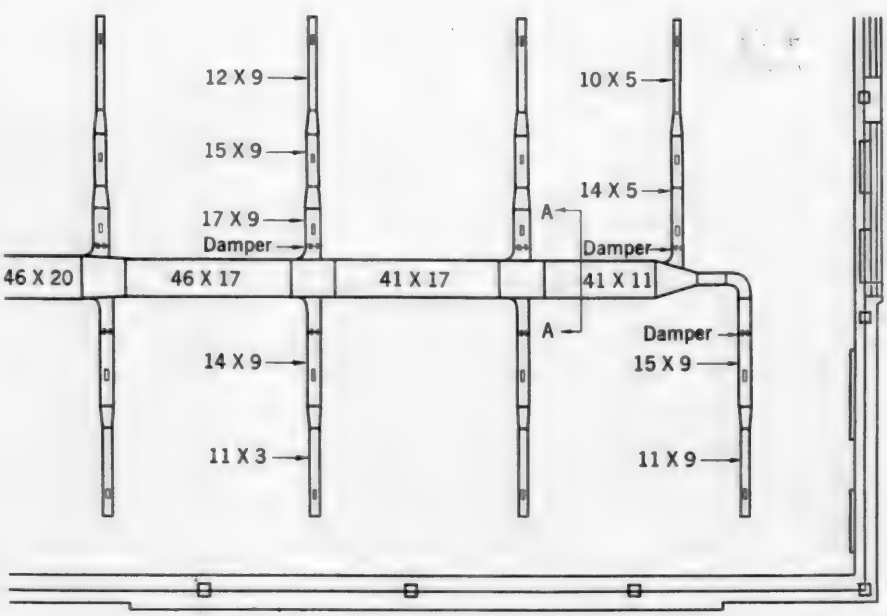


Fig. 1. Typical trunk and finger duct arrangement above a perforated ceiling.

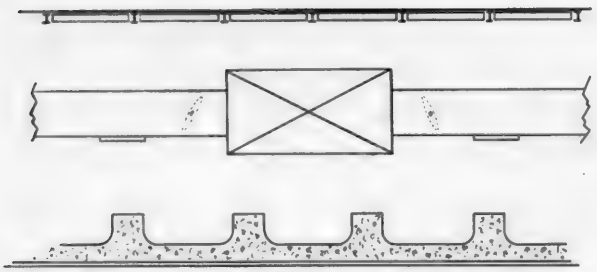


Fig. 2. Section A-A of Fig. 1 showing balancing dampers (where required) and discharge slots.

Pyle National Multi-Vent Panels

This method of providing air distribution differs fundamentally from the others in the basic fact that the velocity through the perforations is considerably higher. The complete panel consists of:

1. A control plate frame to be inserted in the bottom of an overhead distribution duct.

2. An orificed adjustable air valve inserted in the air frame for adjusting the volume of air, irrespective of static pressure in the distributing duct, passing to

3. A perforated distributing plate installed flush with the ceiling or flush with the bottom of an exposed duct work.

The panels are installed with positive connections to distributing ducts and, hence, no plenum is required. The remainder of the ceiling surrounding the panels may be plaster or any other conventional ceiling construction. Obviously, the sheet metal collar extending from the duct to the perforated plate must be the full size of the control plate frame. The panel may also be installed with the perforated plate flush with the bottom of the exposed ducts. In this case, the panel frame projects into the air stream and the manufacturer states that the duct need not be increased at this point, if it already has been sized on a maximum velocity of 1000 fpm, before the insertion of the panel.

Still another method of application provides for the installation of panels in a conventional ceiling forming a plenum. No direct connections are necessary from the perforated panels to the distributing ducts. It follows that the plenum must be made substantially airtight and a system of distributing ducts is required to obtain proper distribution even though no direct connections to the panels are necessary. The manufacturer also offers the adjustable air valve alone, for installing on distributing ducts above perforated ceilings. These valves may only be purchased with the understanding that the design embodies a satisfactory means of blocking off perforations not required and that the effective area of the holes is the same as that obtained with standard complete panels. One valve is to be used for each 250 cfm (or less) and they must be spaced at least 6 ft apart. The manufacturer points out that the cost of the valves, plus extra cost of plenum constructions, blocking off portions of ceiling and partitions in plenum, will often exceed the cost of complete panels.

Some of the early installations proved unsatisfactory because the assumption was made that a single air supply to an extensive plenum covering several bays would give good distribution. Not only did such methods fail to obtain uniform distribution with respect to the volume of air supplied, but with much more serious consequences, such systems could not possibly maintain the required uniform temperature with variable air quantities.

Assume that there is a uniform room sensible heat loading in any given zone. Then it follows that the temperature of the air throughout the zone plenum must also be uniform. Also, the plenum pressure, and therefore orifice velocity, in any given zone with good design will be practically uniform. This shows the need for maintaining a uniform temperature and pressure above the ceiling throughout a given zone. This is accomplished by varying the air supplied through individual supply openings feeding the plenum. Openings farthest away from the point of cold air supply must pass slightly more air than the nearer openings to offset the rise in air temperature within the branch duct.

As a corollary to the foregoing: Any appreciable variation in room sensible heat loading (because of exposure or occupancy) must be handled by separate zones to maintain the required plenum pressures and temperatures, thereby counter-balancing the variations in loading. Therefore, it is important to make partitions fairly airtight in the plenums separating zones.

The function of all perforated ceilings is to lower with a light touch the air into the breathing zone. Its function is not to regulate the volume of air handled nor to change the required temperature of the air as, obviously, it can do neither.

Adjustment of volume dampers at individual duct openings has practically no effect on the volume passing through the ceiling in any given bay (except with Pyle National panels) because this excess volume will pass into other bays above the ceiling. A change in the air supplied by individual openings does effect heat absorbing capacity and temperature distribution in the plenum. This characteristic should be kept in mind when using J. M. and similar ceilings. The principle is entirely different from that underlying the Pyle National unit which maintains room temperature by regulation of volume.

Perforation Area Required

Perforated areas (except with Pyle National panels) should be selected to give not less than 15 fpm nor more than approximately 25 fpm theoretical velocity through the holes. The lower limit is necessary to prevent the stagnant or still air feeling which might result, while the upper is most essential to minimize the secondary induction at each orifice. *It is the induced air which deposits the dust or particulates and causes discoloration of the ceiling.* One has perhaps observed the dust accumulation around ceiling diffusers in air conditioned areas. The familiar "smudge" ring around each, shows in a magnified sense the secondary air motion and dust deposit which would occur at each opening in a perforated ceiling if the discharge jet velocity were too high. Experience of the past 12 years has proven that a velocity of approximately 25 fpm or lower will not produce any appreciable dust accumulation on the ceiling.

Each square foot of perforated plate has 460 holes 5/16 inch in diameter. This gives an opening area of approximately 15½% of the plate area. With a 20 deg temperature differential, it is recommended that the plate area be selected on a basis of 13 cfm per gross square foot of plate area. Therefore, velocity through the openings is theoretically: 13/0.155 = 84 fpm.

When the temperature differential is 10 deg, the panels are selected on a basis of 20 cfm per gross square foot of panel area giving a velocity of 130 fpm. The manufacturer recommends that without cooling and for heating applications, velocities up to 250 fpm through the openings are permissible.

It is important to note the comparison of these velocity ranges with velocities which are encountered by the use of the J. M. Sanacoustic Ceiling. A typical J. M. application, for example, might use 65% of the ceiling in perforated area and each square foot of perforated area has approximately 11.6% openings. Therefore, with an air supply of 1.2 cfm per sq ft, the theoretical velocity is: 1.2/0.65 × 0.116 = 16 fpm.

Fenestra D Panel

The Fenestra D-type 24-inch wide metal panel section is designed for use with the company's cellular type floor. It incorporates a sound absorbing element and has 1150 ⅛-inch diameter perforations per square foot of area thus providing approximately 10% free area. Also available from the company is a Fenacoustic Plate, 12 inches wide, with the same free area as mentioned and having a molded sound absorbing pad similar to the D-panel. These sections are designed to carry their own dead load and the concentrated light fixture load, with supports on a maximum of 12-foot spacing.

Application Details

This information applies where the distribution is above the ceiling. Some details of the design of perforated ceiling systems are still matters of opinion. Nevertheless, sufficient is known to assure satisfactory results if careful attention is given to the many factors involved. The most important general requirement is that the ductwork should be designed substantially as though no ceiling was to be used. The same care must be taken in laying out the ducts for the perforated ceiling system to obtain adequate supply to all areas as is necessary for the conventional system. After this is done, then the ceiling is hung in place. The ceiling should not be depended upon to obtain proper distribution for *the ceiling cannot convey air to areas not otherwise properly supplied.* The ceiling does assist in spreading out the air supply and therefore comparatively large temperature differentials may be used, even with low ceiling heights.

A ceiling having 11.6% perforations with 50% of the ceiling in perforated metal and 1.2 cfm per sq ft of floor area (room or space), will give a theoretical velocity of: 1.2/0.116 × 0.50 = 20.7 fpm.

This is equivalent to room sensible heat loading of 26 Btu per hour with a 20 deg temperature differential. With lower sensible heat loadings the design temperature difference may be decreased or the amount of perforated ceiling reduced to maintain a minimum velocity of 15 fpm.

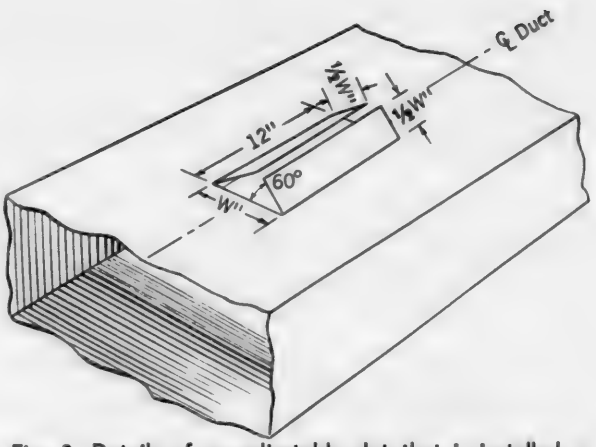


Fig. 3. Details of an adjustable slot that is installed so that there is one per bay.

Frequently lights are recessed into the ceiling and a large percentage of the heat from lights is taken up in the plenum. Therefore, the actual temperature difference from ceiling to room may be considerably less than the overall difference. On the other hand, an overall temperature difference much greater than 20 deg, including light heat, will not give sufficient velocity through the holes.

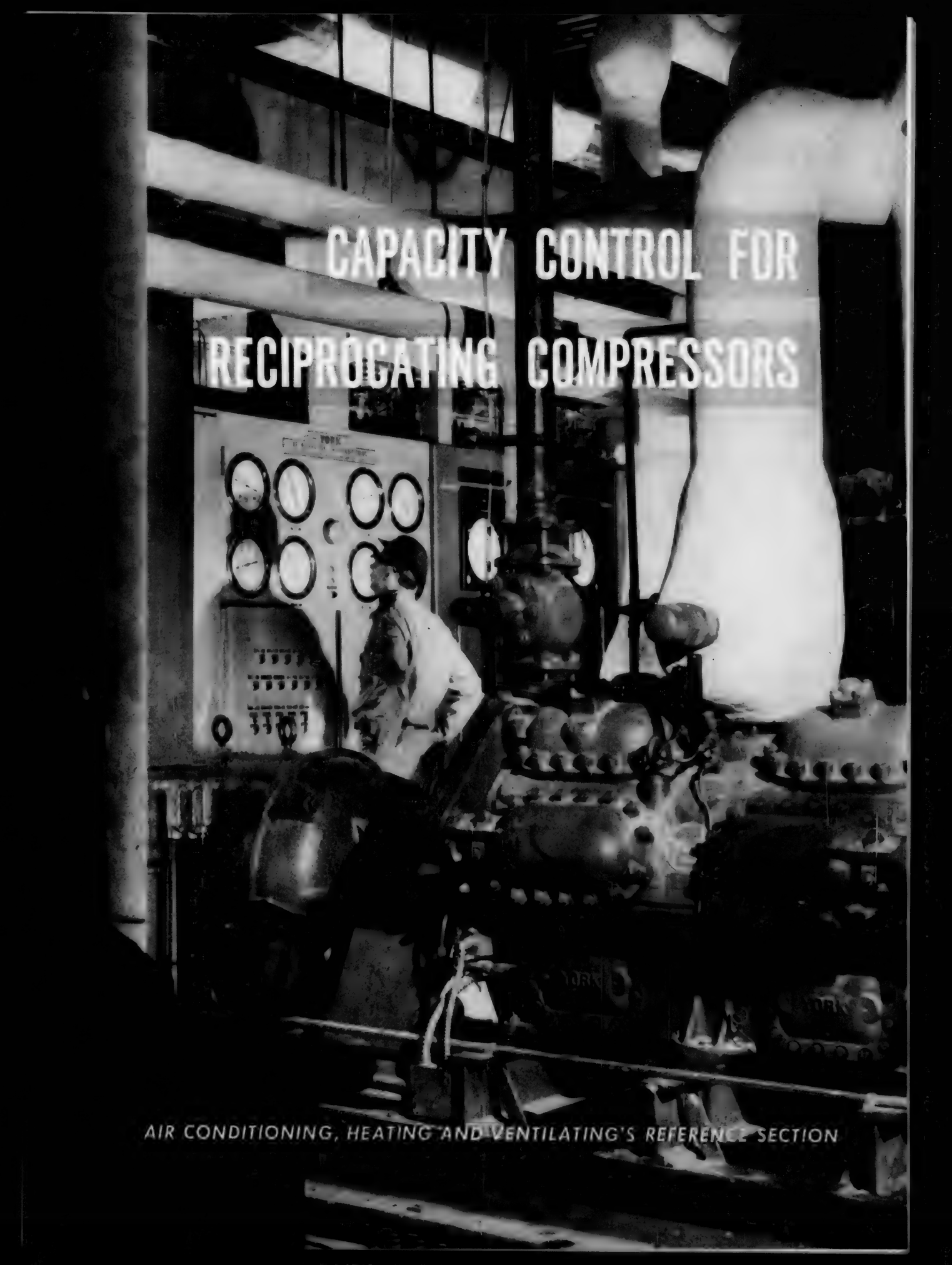
With a plenum located below an unconditioned floor or roof, the heat gain through this section must be considered in determining air volume and total loading. Similarly, where the floor below is also conditioned, there is a flow of heat from the conditioned room to the plenum below.

Duct Design

Duct distributing systems have usually been designed on the basis of conventional low velocities; nevertheless, there appears to be no good reason why medium or comparatively high velocities could not be used to obtain the advantage of such a design. A very important matter in this connection is the method of releasing the air from within the duct into the plenum.

Air leaving the supply openings at too great a velocity and too near the perforated ceiling, may cause induction of room air upward through the perforations and spotty discoloration of the ceiling is practically inevitable. It is necessary to avoid impingement of air directly on the ceiling. All systems, regardless of duct pressure, should be provided with a means of introducing the air into the plenum in a manner to avoid any appreciable velocity in contact with the ceiling. A method which appears to be sound is the use of "inverted discharge" from the top side of the duct. The air is discharged directly below the floor slab. Velocity is quickly dissipated and there is little danger of secondary movement of room air. Each such opening should be adjustable and accessible by removing a ceiling tile. At this point it is again well to emphasize, *every effort should be made to obtain good distribution without depending on the ceiling to maintain distribution.*

Figures 1, 2 and 3 show typical main trunk and finger arrangement above the hung ceiling.


CAPACITY CONTROL FOR
RECIPROCATING COMPRESSORS
AIR CONDITIONING, HEATING AND VENTILATING'S REFERENCE SECTION

Capacity Control for Reciprocating Compressors

A comprehensive study of the various means for providing automatic capacity control to meet variable load conditions. Wiring and piping diagrams are included for a better understanding of control operation.

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EXCEPT IN RARE CIRCUMSTANCES, any air conditioning or refrigeration system will be required to operate at variable load conditions due to changes in occupancy, solar effect, outside dry bulb and wet bulb temperatures, wind velocities and internal heat generating sources. It then becomes necessary for the mechanical cooling system to adjust its capacity to meet the instantaneous load requirement.

Foremost in the design of the system is the gas pumping capacity of the compressor—the means provided to regulate the refrigerant flow rate. Methods of regulating the effective gas pumping rate of a reciprocating compressor may be as follows:

1. Compressor cycling.
2. Evaporator pressure regulator.
3. Gas bypass around the compressor.
4. Unloading compressor cylinders.
5. Combination of any of the above.
6. Miscellaneous less common methods.

Compressor Cycling

This method of capacity control is quite commonly used on smaller factory packages, usually up to about 7.5 hp for a single compressor unit and to about 30 hp in commercial type units containing three or more refrigerant circuits. On larger size systems, this method is generally not acceptable for several reasons:

1. Continuous cycling of larger electric motors results in motor overheating and greatly shortens the life of the motor.

2. Intermittent compressor cycling will result in some deviation in the conditioned space relative humidity due to re-evaporation of moisture on the evaporator secondary surface, particularly on a single compressor installation.

3. Other disadvantages are the frequent voltage dip in the building power supply due to the compressor motor in-rush requirements, which may result in light flicker which is objectionable, overload on other motor circuits and instrument failure; higher operating cost due to the increased electric demand; and higher operating costs due to the larger compressor pumping head required for full load operation.

Evaporator Pressure Regulator

The gas pumping ability of a reciprocating compressor is a function of the specific volume of the refrigerant vapor and of the compression ratio it is pumping against. If the suction gas line to the compressor is throttled, the refrigerant vapor assumes a larger specific volume, due to the lower pressure, and the compressor must pump through a higher compression ratio in elevating the gas from the lower pressure to condensing pressure. The higher compression ratio results in more re-expansion of discharge gas from the clearance pockets in the compressor, allowing less space for evaporator gas during the compression stroke.

Consequently, a gas throttling valve may be located between the evaporator and the compressor and be set to maintain a fixed evaporator pressure. The suction pressure to the compressor adjusts itself to balance the flow rate from the evaporator with the flow rate through the compressor. Evaporator pressure regulator valves, available from a number of valve manufacturers, will prevent the temperature of the cooled medium from falling below a pre-determined

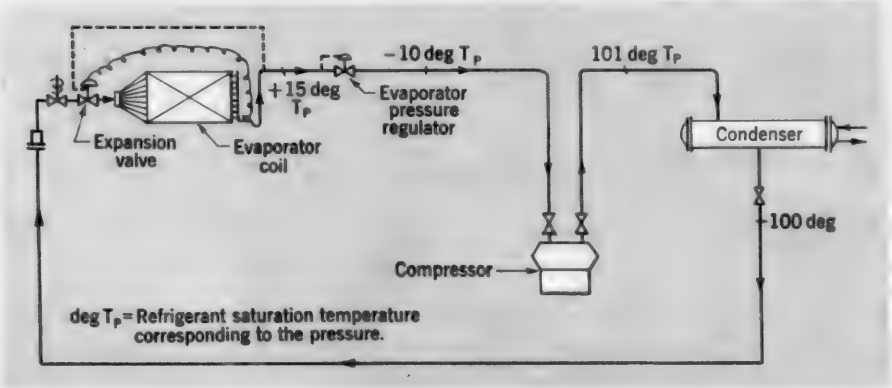


Fig. 1. Use of evaporator pressure regulator to control system capacity.

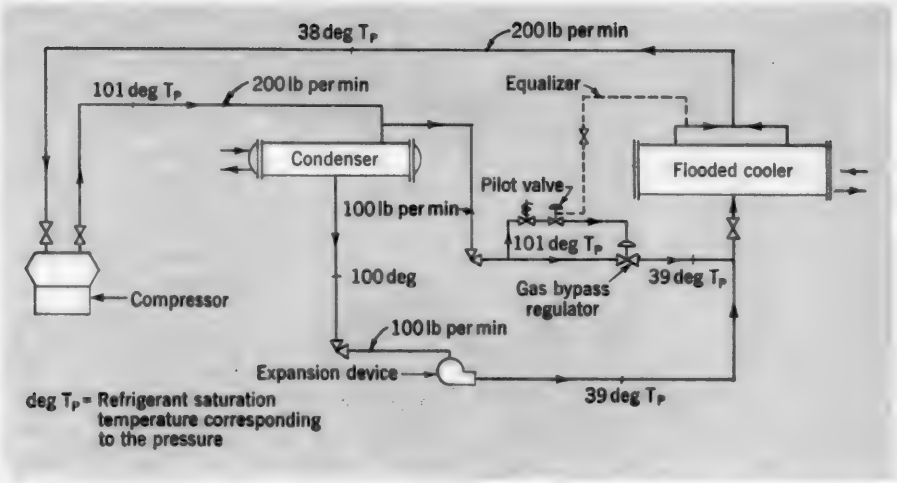


Fig. 2. Use of discharge gas bypass to control system capacity.

level. Figure 1 illustrates the use of an evaporator pressure regulator on a system containing a direct expansion coil. Here it is set for 15 deg F evaporator temperature. A good valve will maintain this upstream pressure down to very low load condition. On the downstream side of the valve, the pressure is shown to be —10 deg T_p resulting in a 25 deg equivalent pressure differential across the valve to balance the compressor capacity with the actual evaporator load.

When the gas flow to the compressor is throttled, the compressor must pump the refrigerant vapor through a larger pressure differential, requiring a greater amount of energy to compress each pound of refrigerant. Therefore, this method of capacity control is quite inefficient. Another objection to this method of control is the more severe operating conditions which will shorten the life of the compressor. Pumping from low suction pressure increases the compression ratio and pressure differential across the compressor, causing more stress and wear on the wrist pins, crankthrow bearings, and suction and discharge valves. Also, it does not provide close temperature control since it maintains a nearly constant evaporator temperature. For part load operation, the air or process fluid will be cooled to a lower temperature than the design point. The latter can be overcome by either providing a pneumatically compensated evaporator pressure regulator circuit with the necessary thermostat, or multiple evaporator circuits with individual solenoid valves to permit reduction of evaporator surface for part load operation.

Evaporator pressure regulators are more commonly used to prevent freezeup in water chillers, to avoid frost formation on direct expansion air cooling coils, or for capacity control at individual evaporators operating at different temperature levels with a common suction pressure.

Discharge Gas Bypass

With this arrangement, compressor discharge gas is bypassed around the condenser and back to the low side of the system in an effort to maintain a constant gas pumping rate through the compressor, while limiting the actual evaporation rate from the evaporator. A typical arrangement, which contains a flooded cooler, is illustrated in Fig. 2. Discharge gas, bled from the line between the compressor and the condenser, is directed through a pressure regulating valve to the bottom of the flooded cooler. On larger systems, the regulator valve will generally be the pilot operated type with a small pilot valve controlling the position of the valve stem in the regulator. The gas equalizer from the pilot valve senses evaporator pressure. Should the evaporator pressure fall below the spring setting of the pilot valve, it opens and bleeds discharge gas to the diaphragm or control piston of the regulator, causing it to open. As the evaporator pressure exceeds the pilot valve setting, it closes and an internal bleeder in the regulator equalizes both sides of the piston or valve diaphragm, permitting a spring and/or discharge pressure to close the regulator valve. For normal operation, both the pilot valve and the regulator modulate to maintain steady state conditions and automatically readjust themselves for changing load conditions. The pilot equalizing line should always be vented to the evaporator or the suction line returning to the compressor and not downstream from the regulator. Any gas flow through the regulator results in pressure drop in the gas line to the evaporator. Equalizing to this line would result in very sporadic operation of the regulator since it would not give a true indication of evaporator pressure. A solenoid valve is often used in the pilot valve circuit to provide positive valve close-off when gas bypass is not desired. This same basic design can be applied to direct expansion systems with the bypass gas injected ahead of the distributor, if used.

The compressor gas bypass method is much less commonly used today than it was many years ago when compressors were not available with automatic unloading mechanisms. By itself, it is inefficient since the quantity of refrigerant vapor flowing through the compressor is essentially constant, regardless of the actual evaporator load, requiring full load horsepower for all operating conditions. Today, its most common use is in conjunction with compressor cylinder unloaders as a further increment of capacity reduction below the minimum capable of the compressor.

Unloading Compressor Cylinders

Most high speed reciprocating compressors, sizes 10

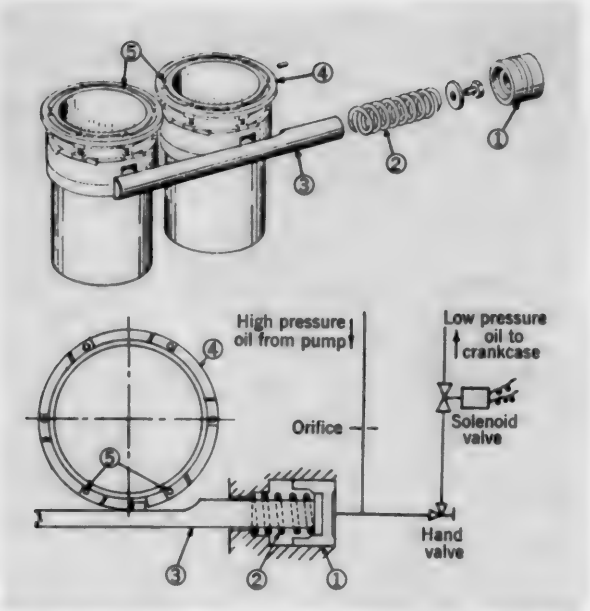


Fig. 3. Capacity unloader mechanism. Courtesy, York Corporation.

hp and up, are equipped with automatic unloading devices. This is a most desirable method of matching the compressor capacity to the evaporator load since it is very efficient and does not heavily burden the working parts of the compressor. Most of these compressors are mechanically unloaded by built-in mechanisms which hold either the suction or discharge valves in the open position. In this way, the unloaded pistons are not pumping the gas through a differential pressure other than a slight loss through the open valve.

The method of powering the unloading mechanism may be with oil pressure from the compressor lubricating pump or compressor discharge vapor. Groups of cylinders on a multicylinder compressor can be unloaded by providing individual solenoid valves or a multi-step pressure regulator. As many as six reduction increments may be set on a single compressor.

Figure 3 illustrates one method of cylinder unloading. This unloader mechanism operates two cylinders at a time, utilizing oil pressure from the pump and electrically operated solenoid valves for control. When the compressor is not in operation, the unloader mechanism is in the position shown and the unloader spring (2) pushes back the unloader piston (1) and the unloader rod (3). This turns the cam rings (4) so that the lift pins (5) are raised on the cams. This holds the suction valve off its seat against the valve springs. The unloader stays in this position until the compressor has been started and oil pressure buildup by the oil pump pushes the unloader piston against the unloader spring. The motion is transmitted as before to lower the lift pins and allow the valve to seat itself. The oil pump pressure is introduced through an orifice to exert oil pressure on the unloader piston when the solenoid valve is closed. When the solenoid valve opens, the pressure in the line and on the unloader piston is reduced to crankcase pressure since the orifice restricts the rate of oil flow from the pump and has much less flow capacity than the solenoid valve.

Individual loader mechanisms are provided for groups of two or more cylinders to permit multiple steps of reduction on a single compressor. The solenoid valves are controlled directly by a thermostat or pressure controller, or indirectly by a step controller.

Another method of cylinder unloading is illustrated in Fig. 4. The operation of the cylinder unloaders is as previously described, but the individual solenoid valves are eliminated and the crankcase capacity control valve is substituted. The capacity control regulating valve may control suction pressure directly, or may be pneumatically compensated by a thermostat to control air, water, or brine temperature. The capacity control valve may be located in one of the compressor crankcase coverplates. This valve is actuated by high pressure oil from the discharge side of the oil pump and its function is to admit or relieve oil pressure to or from the individual unloader mechanism, depending upon the suction pressure and/or pneumatic pressure from a remote control.

The capacity control regulating valve is also located as an integral part of the compressor. It is actuated by a change in balance between the crankcase pressure on one side of the valve diaphragm, and the tension on the adjustable spring on the opposing side of the diaphragm. Increased crankcase pressure closes the valve and decreased crankcase pressure opens the valve. The function of the valve is to regulate the oil pressure which actuates the capacity control valve. The action of the regulating valve permits the capacity control valve to automatically load or unload cylinders. Individual oil lines are run to each unloader piston. The control piston in the capacity control valve covers or uncovers the various oil lines to the unloader mechanisms, depending upon the capacity required.

Efficiencies

Figure 5 illustrates the relative efficiencies of the compression equipment for the various methods of system capacity control described. The compressor brake horsepower required per ton of effective refrigeration offers the best comparative figure since it reflects the actual operating cost to the user. The conditions used in formulating the horsepower requirements shown on this graph were a constant process (air, water or brine) temperature leaving the evaporator and a fixed wet bulb temperature at the evaporative condenser. It is obvious that the gas bypass method is the least efficient. This is because the compressor must pump a nearly constant quantity of refrigerant vapor from the evaporator to the condenser. It is even less efficient than the evaporator pressure regulator method since with the latter, the gas density is greatly reduced at part load duty, lowering the horsepower required by the compressor below that of the full load value. However, the tonnage in the evaporator reduces and in balancing the compressor capacity at a lower suction pressure, the horsepower per ton increases as shown.

The compressor cycling horsepower requirements for the conditions noted, are essentially constant since whenever the compressor is operating, it has the design temperature split at both the evaporator and at the condenser.

The unloaded compressor cylinder method results in

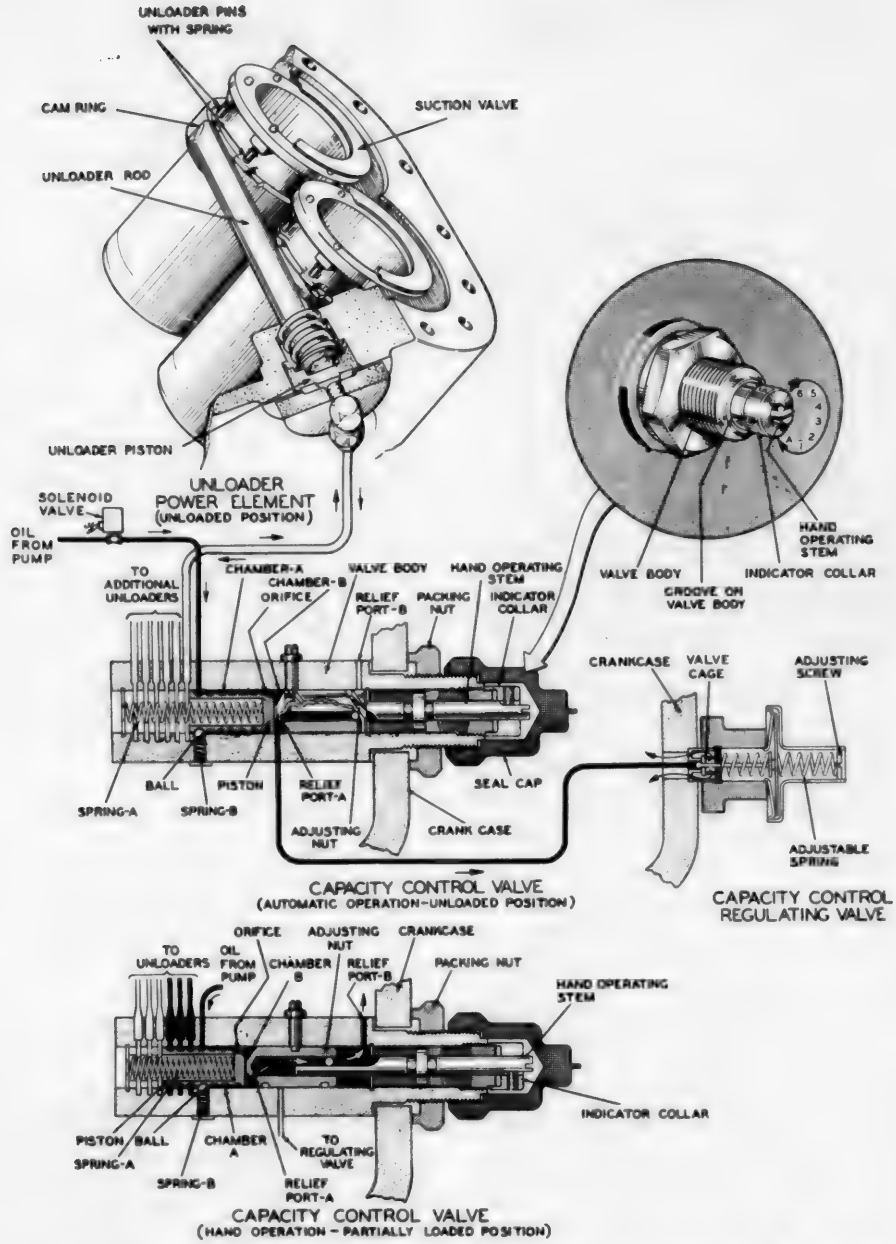


Fig. 4. Suction pressure control unloader arrangement. Courtesy, York Corp.

the most satisfactory part load performance of any method, requiring less than 0.75 bhp per ton of refrigeration at 25% evaporator load. At the design evaporator and condensing temperatures, the compressor itself is actually slightly less efficient for part load operation than for the full load duty due to friction at the unloaded cylinders. However, when operating at partial load, the evaporator temperature split and the condenser temperature split are both greatly reduced, permitting a reduced pumping head. These reduced temperature splits permit the system with compressor cylinder unloaders to operate more efficiently than a system controlled by compressor cycling.

Combinations

A combination of any of these methods of unloading may be used to obtain optimum efficiency and/or to permit capacity reduction below the minimum available for a given method. If a single reciprocating compressor on a system is capable of reduction to 25% of the full load duty, there may be times when the actual evaporator load falls below even this, particularly on refrigeration systems which must operate throughout twelve months of the year. In some instances, the controls will be arranged to permit the compressor to unload to its minimum step of operating capacity and then cycle on and off the line for load requirements

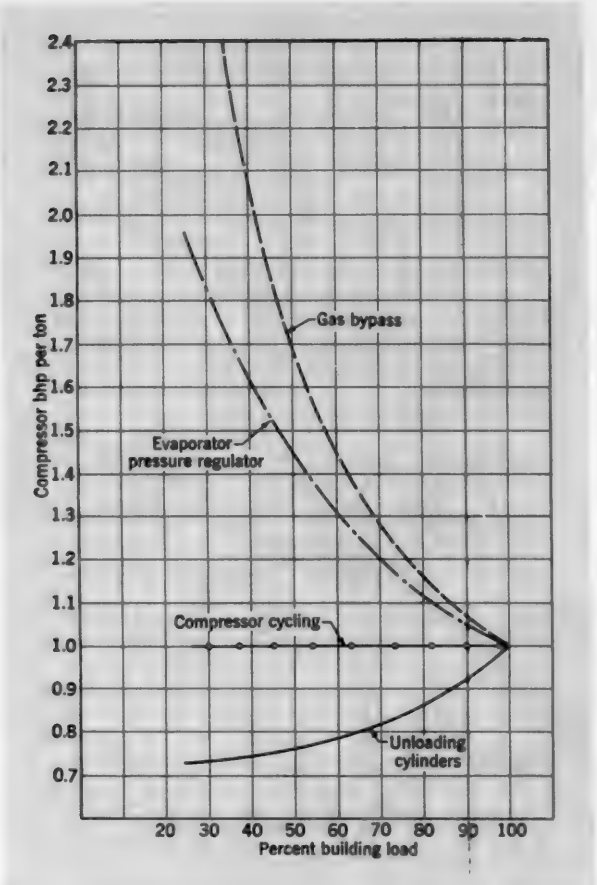


Fig. 5. Compressor horsepower for different unloading methods.

below this. On others, the discharge gas bypass method will be incorporated to keep the compressor running, even if the load falls to nothing. This may be done to maintain sufficiently high suction gas riser velocities for oil return, to maintain close control of humidity or temperature in process work, or to prevent compressor motor cycling which can cause overheating, or voltage dips in the power supply which may affect sensitive instruments in, for instance, a laboratory.

An evaporator pressure regulator may also be used in conjunction with a compressor containing unloader mechanisms. Again, the compressor should be permitted to unload to its minimum step of capacity before the regulator takes over, in order to permit even lower increments of cooling in an effort to minimize or eliminate compressor cycling.

Miscellaneous Less Common Methods

Several other methods have been used to regulate the effective refrigeration capacity of systems. Most of these are seldom used and, therefore, will only be discussed briefly. Wound rotor motors have been used on some reciprocating compressor applications for speed control, which in turn, regulate the gas pumping capacity of the compressor. For the most part, speed regulation is limited to a minimum of 50% of the full load speed, resulting in a minimum step of capacity of approximately 50%. Due to the high cost of the wound rotor motor and the external secondary resistors, this method of control is usually impractical. Compressors equipped with capacity unloaders are relatively inexpensive and most offer capacity increments below 50%. Furthermore, the operating cost of the variable speed motor is quite high due to its inefficient operation at lower speeds wherein heat is dissipated in the external resistors.

A two-speed electric motor has been used on a few occasions to drive a reciprocating compressor. However, the high cost of the motor and motor controls are difficult to justify for the single step of capacity reduction available when compared with individual cylinder unloaders.

On some low temperature systems, the compression equipment is permitted to "bottom out" when the evaporator load is reduced. This may only be done when there is no freeze-up hazard. It is objectionable due to the higher operating cost and the increased wear on the compression equipment due to operation at higher pressure differentials.

Another method of capacity control is the use of an artificial load on the evaporator side of the system. Electric heat or steam may be used as a heating source to add to the actual evaporator load to bring it in balance with the compressor capacity. Again this is a most inefficient method and would likely only be used on extremely small installations where operating costs are relatively unimportant.

Control Mediums for Regulating Compressor Capacity

The control medium which signals the compressor when to change capacity may be either the refrigerant, a pneumatic signal, or an electrical signal. When the refrigerant serves as the control medium, a sensing valve is located at some point on the low side of the system, usually in the compressor crankcase which is a measure of suction pressure. Such an arrangement is illustrated in Figure 4. As the suction pressure to the compressor increases, this is indicative of an increased loading on the evaporator and the compressor should load additional cylinders to satisfy the evaporator load. The increased refrigerant pressure acts against the pressure regulating valve which restricts the oil flow from the capacity control valve, causing a pressure buildup which will render additional cylinders operative. For a decrease in suction pressure, the capacity control regulating valve assumes a more nearly open position which bleeds a higher rate of oil from the capacity control valve, unloading some of the cylinders.

On some installations, control of evaporator pressure is not sufficiently accurate for satisfactory control. The temperature split in the evaporator between the refrigerant and the cooling medium (air, water or brine) is a function of the loading per square foot of evaporator surface. If the entire evaporator surface remains in operation for partload duty, the temperature split will decrease, nearly in proportion to the load. Therefore, if the evaporator pressure is held fairly constant, the cooling medium will be chilled to a lower temperature for a part load duty. If this is undesirable because of a freezeup hazard, or due to the

need for a more constant control temperature, a thermostat should be installed to control the fluid temperature directly.

When the refrigerant evaporator pressure regulates the capacity of two or more compressors on a common system, a problem is encountered with the starting and stopping of the second or third compressors. An electric circuit must be energized to bring the second compressor into operation, requiring an electric signal from control separate from the compressor unloader mechanism. Since the compressor capacity regulator operates over a small proportion band, it is difficult to adjust a pressure electric switch to bring in the second compressor when necessary and to cut it off the line when it is not needed.

Where suction pressure is inadequate, the same arrangement illustrated in Figure 4 may be used, with the addition of a pneumatic controller. The control line is connected to a tapped opening on the right side of the diaphragm on the capacity control regulating valve. Otherwise, this side of the diaphragm would be vented to the atmosphere. The pneumatic signal from the thermostat then opposes the crankcase pressure and spring in the regulating valve so the thermostat can directly control the compressor capacity by imposing controlled pressure on the diaphragm of the regulating valve.

If the compressor is equipped with solenoid valve unloading mechanisms, the signal to the compressor must be an electric one. A simple type is the multi-step thermostat with a bulb located in the cooling medium circuit. By using a multistep thermostat with individual contacts for each solenoid valve on the compressor, individual steps of capacity can be controlled with different temperature settings for each contact. The preferred location of the bulb is in the return circuit to the evaporator.

Another method is the use of individual pressure-electric switches equalized to the suction line of the compressor, each connected to a different solenoid valve unloader on the compressor. By setting the pressure electric switches at different pressure levels, sequence control of the compressor unloading can be obtained.

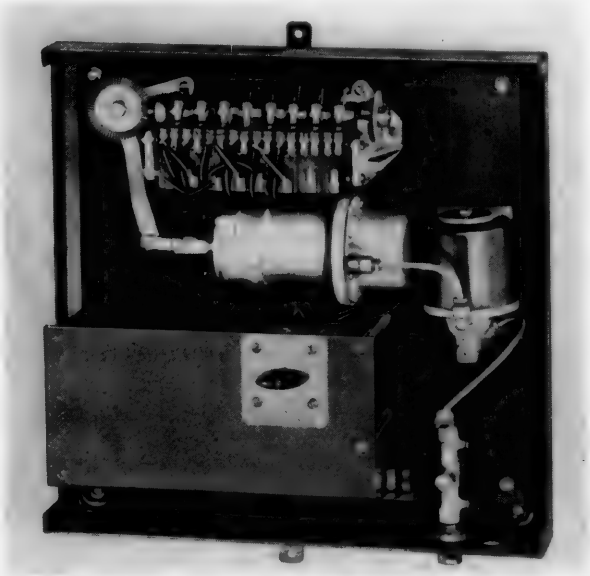


Fig. 6. Pneumatic step controller. Courtesy, Johnson Service Co.

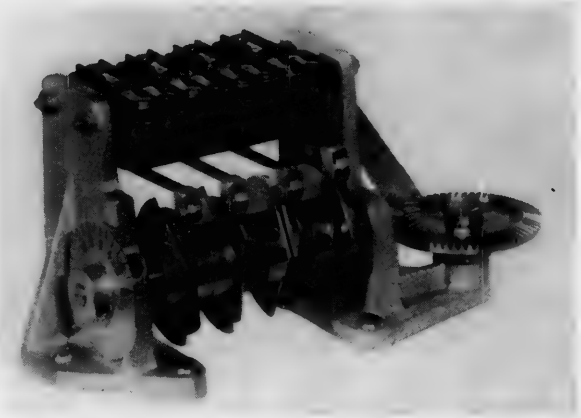


Fig. 7. Sub-assembly of pneumatic step controller. Courtesy, Johnson Service Co.

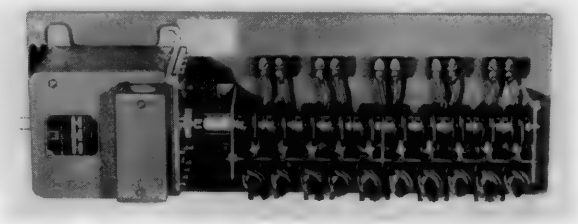


Fig. 8. Electric step controller. Courtesy, Minneapolis-Honeywell Regulator Co.

Even another method is the use of an electric step controller with either a pressure or a temperature controller regulating the position of the step controller motor. The step controller serves as a sequence switch and contains multiple electric switches, actuated by cams which are adjustable. The electric switches are wired in series with the solenoid valves on the compressor to permit incremental capacity control.

A pneumatic temperature or pressure controller in combination with a pneumatic step controller, containing electric switches, is also commonly used to regulate the unloader solenoid valves. The pneumatic step controller rotates a cam shaft which actuates individual switches in sequence. The electric switches on the step controller are wired in series with the unloader solenoid valves on the compressor.

Step Controllers

Step controllers have performed a valuable service to the air conditioning and refrigeration industry throughout the years as a means of regulating compressor capacity. Not only do they permit close control when used with the proper type of controller, but they are extremely valuable for the many special features they offer. Some of these are:

1. Allow individual adjustment of the settings between the make and break contacts.
2. Permit the control of multiple compressors in nearly any sequence.

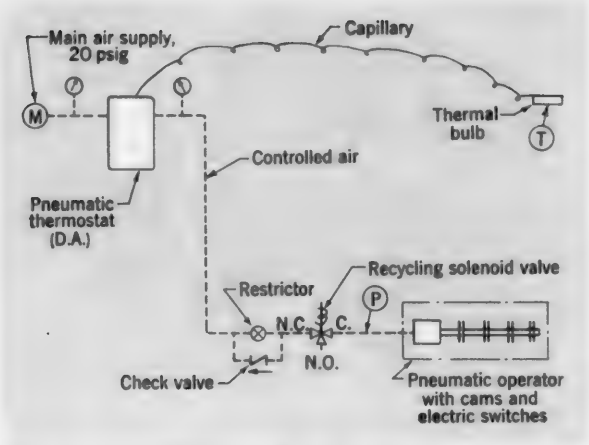


Fig. 9. Temperature control with pneumatic step controller — single system.

TABLE 1 — TYPICAL CONTROL SCHEDULE WITH BULB LOCATED IN RETURN WATER LINE TO CHILLER

P Controlled Air Pressure, Psig	Temperature at Bulb Deg F	Per Cent Compressor Capacity
3	45	0
5.5	47	25
8	49	50
10.5	51	75
13	53	100

3. Provide sequence control of cooling tower pumps, evaporative condenser fans and pumps.
4. Incorporate recycling features so that with proper wiring, the compressor must start at minimum capacity if it goes off the line for any reason.
5. As an optional feature, some setups offer transfer switches which permit the wear to be equalized on different compressors by switching the lead compressor.
6. Permit simultaneous loading and unloading of two or more compressors on a compound system.
7. Permit the use of different thermostats or pressure controllers on a single step controller (that is, heat pump systems).
8. By means of adjustment, any time lag can be provided between steps of individual compressor capacity or between compressors.

A step controller may be either a pneumatic or an electric type. The pneumatic type has an air operated piston which takes a signal from a thermostat or pressure controller and through a gear train and lever mechanism, regulates the position of cams which control microswitches or mercury bulbs. Figure 6 shows a typical pneumatic step controller. Air flow enters the bottom connection to a restrictor which serves as a regulating device to obtain variable time lag between steps of capacity increase. The check valve around the restrictor permits the step controller to unload rapidly when necessary. The air flows from the restrictor through a 3-way solenoid valve which bleeds the air piston to atmosphere upon interruption of current. When the solenoid valve is energized, it feeds air from the restrictor to the air piston which then rotates a cam shaft. On the front of the unit is a sequence switch which permits manual repositioning of the lead compressor on an installation containing as many as three compressors.

Figure 7 shows a detail of the cam shaft and the individual micro-switches. Note that for each microswitch, there are two cams, each individually adjustable. This permits adjustment of a variable differential between the make and break of each switch.

The electric step controller receives its signal from an electric thermostat or pressure controller and serves to reposition an electric motor which is designed to permit rotation in either direction. Figure 8 shows a typical electric step controller. The rotation of the motor operates a cam shaft with two sets of cams for each mercury bulb, which is wired in series with the compressor starter holding coil or individual solenoid unloaders.

TABLE 2 — TYPICAL CONTROL SEQUENCE WITH BULB LOCATED IN RETURN WATER LINE TO CHILLER

(Refer to Fig. 10)

T Temp. at Bulb, Deg F P_C	Output Pressure from TH-1, Psi	P_A Output Pressure from PR-1, Psi	Per Cent Capacity, System "A"	P_B Output Pressure from PR-2, Psi	Per Cent Capacity System "B"
45	2	0	0	0	0
46.7	5	4	33	0	0
48.4	8	8½	67	0	0
50	11	13	100	0	0
51.7	14	17½	100	4	33
53.4	17	20	100	8½	67
55	20	20	100	13	100

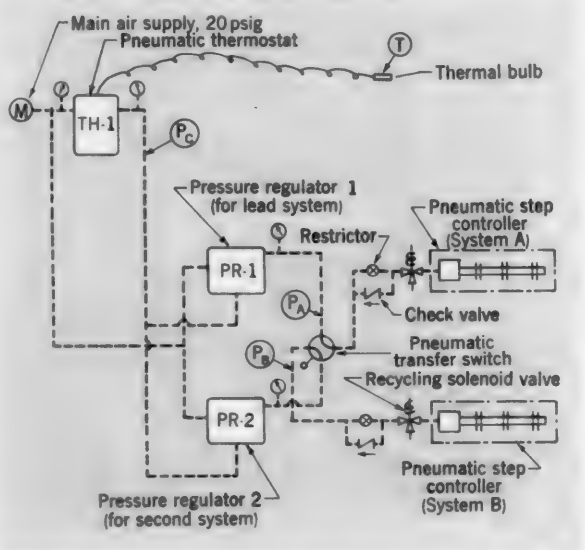


Fig. 10. Temperature control with pneumatic step controllers — two systems.

Both types of step controllers may be purchased with single pole double throw switches to permit either current supply or current interruption for each step, depending upon the operation desired.

The use of individually adjustable make-and-break cams is more desirable than a single cam with a fixed differential on systems where a single step controller will control two or more compressors. When the evaporator load falls between the capacity of the first and second compressors, excessive cycling may be encountered, if the second compressor is permitted to cycle to match the load requirements. A far better method is to overlap the 100% increment of the first compressor with the minimum capacity increment of the second compressor. For instance, on an installation containing two compressors, each with three steps of capacity reduction, the operating sequence for an increasing load would be 33%, 67%, and 100% of the lead compressor, and 33%, 67%, and 100% of the second compressor. For a reduction in load, the second compressor would unload to its minimum step of 33%, wherein the first compressor would unload to 67% before the second compressor is permitted to go off the line on a further reduction. In this way, any load condition above the minimum capacity of the lead compressor will not result in the compressor motor cycling for a steady load condition.

Application of Pneumatic Step Controllers

A pneumatic controller is of the proportioning type. By this is meant that the temperature or pressure controller will send out a variable pneumatic signal as a function of the temperature or pressure measured. For each temperature or pressure level, there is a fixed air pressure output and the output pressure will never be the same for two different measured conditions.

Figure 9 shows a typical pneumatic control circuit incorporating a pneumatic step controller with a thermostat. In this instance, the thermal bulb is located in the water return line to the chiller. As the return water temperature rises, the direct-acting pneumatic thermostat sends an increased air pressure through the control line to a restrictor and then through the 3-way solenoid valve to the step controller operator. As the air pressure to the step controller increases, the cam shaft rotates in a direction to reposition additional micro-switches which will add steps of compressor capacity. As the return water temperature decreases, the pneumatic thermostat bleeds air from the step controller air operator and a spring repositions the piston, rotating the camshaft to unload steps of capacity.

The restrictor in the control line is a metering valve which restricts the air flow to the step controller operator. It is adjustable and serves to provide any amount of time lag desired between increased steps of compressor capacity. The check valve around the restrictor permits air to be bled from the air operator rapidly with no time lag. This is desirable from the standpoint that the compressor can unload sufficiently rapidly to prevent nuisance shutdowns by one of the low temperature or low pressure safety switches. For instance, when a water cooling system starts in the morning after night-time shutdown, it will load up to full capacity for a short time interval, at least until the mass of the water in the system has been cooled. At the end of the pulldown during mild weather, it is important that the machine unload rapidly to prevent tripping out on one of the safety switches. The latter would cause excessive compressor cycling.

An adjustable time lag is desirable with increasing steps of capacity to permit the evaporator expansion valves to adjust themselves to the compressor capacity and to prevent hunting of the capacity control, which will occur if the response is too rapid.

The 3-way air solenoid valve serves as a recycling control to bleed air from the step controller whenever the electrical circuit is de-energized. If properly located in the electric control circuit, it will recycle the compressor so it can only start at minimum capacity in the event of current interruption due to power failure or a safety control.

Table 1, which is used with Fig. 9, represents a typical control schedule with the thermal bulb located in the return water circuit. Since the pneumatic thermostat is of essence a proportioning type, it will send a different pneumatic signal for each temperature measured. For an installation designed to cool water from 53 to 45 deg, the control schedule should permit the compressor to load to 100% capacity if the return water is 53 deg, and to zero capacity if the return water is 45 deg. Intermediate temperatures will result in output pressures proportional to the temperature. For instance, when the return water is 49 deg, it need only be cooled through a 4 deg range to satisfy the 45 deg leaving condition and 50% compressor capacity will handle this.

Another control arrangement involves locating the thermal bulb in the water line leaving the chiller which, in the writer's opinion, is less satisfactory than the return water location. With the bulb on the leaving side of the chiller, the differential on the thermostat

ELECTRICAL CONTROL DIAGRAM NOMENCLATURE

CDWP—Condenser water pump motor starter
CHWP—Chilled water pump motor starter
CMS—Compressor motor starter
CRS—Capacity reduction solenoid valve on compressor
EP—Electric pneumatic control (3-way solenoid valve)
FDS—Fused disconnect switch
HP-LP—High pressure-low pressure compressor cutout
IT—Interval timer
LWT—Low water temperature safety thermostat
M—Motor of step controller
OFS—Oil failure switch
OL—Motor overload protection
R—Electric relay
R_1—Electrical resistance circuit
R_2—Electrical resistance circuit
SC—Step controller contact switch
SW—Switch
TR—Transformer
V—Voltage
1XX1—Hot side of single phase circuit
1XX2—Grounded side of electrical circuit

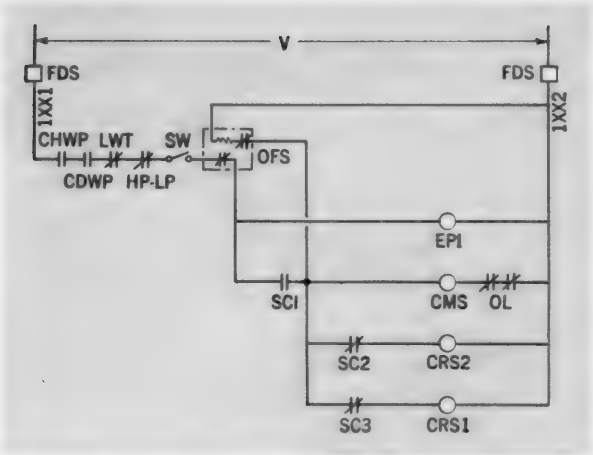


Fig. 11. Typical control wiring diagram — pneumatic step controller.

must be considerably less to maintain a tolerance of approximately plus or minus 1½ deg on the leaving water side. The air output signal from the pneumatic thermostat would then be 13 lb when the leaving water temperature is 46.5 deg, and only 3 lb when it is 43.5 deg. This requires a greater sensitivity setting on the thermostat, making it more difficult to adjust both the thermostat and the cam settings. Also, the inherent time lag of the entire water circuit is lost.

Figure 10 shows a similar arrangement, but for two systems each with an individual step controller. A single step controller may be used for two or more systems, but the use of individual controllers has many advantages.

Instead of the pneumatic thermostat controlling both step controllers simultaneously, pressure regulators are interposed between the thermostat and each system step controller. The pressure regulators permit different air output signals to the individual step controllers so both systems can be sequenced. If the two-step controllers were permitted to operate directly off the thermostat, both systems would operate simultaneously resulting in excessive cycling and increased system wear and operating costs. A pneumatic transfer switch is located in the control circuits between the pressure regulators and the step controllers so that the lead system may be changed periodically to equalize wear on both systems. It is only necessary to turn the switch in the opposite direction to change lead systems.

Table 2, used with Figure 10 shows the pneumatic control schedule as a function of return water temperature. The design water temperature leaving the chiller is assumed to be 45 deg. When 45 deg water returns to the chiller, the pneumatic thermostat *TH* sends out a signal of 2 lb, resulting in pressure outputs from *PR-1* and *PR-2* of zero pounds. Consequently both systems will be shut down.

As the return water temperature rises, the air output signal from *PR-1* increases with an increased input signal, loading the lead system capacity to balance the building load. After the lead system is 100% loaded, pressure regulator *PR-2* puts out an air signal to the second system step controller, adding its capacity to handle the building load requirements. For 55 deg return water temperature, the thermostat may send out a signal of 20 lb, which would result in pressure inputs to each step controller of 13 lb or more, operating both systems at 100% capacity.

When two or more water chillers operate in parallel on a common water circuit, this control sequence may not be satisfactory unless no water flow is permitted through an idle chiller. If the return water temperature is 50 deg, the lead system would be operating at 100% capacity and would cool the water through a 10 deg range to 40 deg. The 50 deg return water bypassing through the idle chiller would mix with the 40 deg water to provide the desired mixture temperature of 45 deg.

However, if the system were designed for 40 or 42 deg leaving water temperature, the low water temperature off an operating chiller at 100% capacity with another idle, would result in a leaving temperature between 35 and 40 deg. This is somewhat hazardous from the standpoint of freeze-up. Therefore, where this condition is encountered, it is desirable to arrange the control sequence so that the second system may cut in when the lead system is at perhaps 60 or 75% capacity. In this manner, the water range through an operating chiller will be less for the condition where the other system is idle, and leaving water temperatures will be higher and safer.

Figure 11 shows a typical electrical control diagram incorporating the pneumatic type step controller. *EP-1* is an air solenoid valve located on the step controller and serves to bleed air from the air piston in the event of current interruption. This solenoid valve is wired in series with the various compressor safety controls and the compressor switch. If any of the safety controls interrupts current to the compressor motor starter holding coil, the air solenoid valve will becomes de-

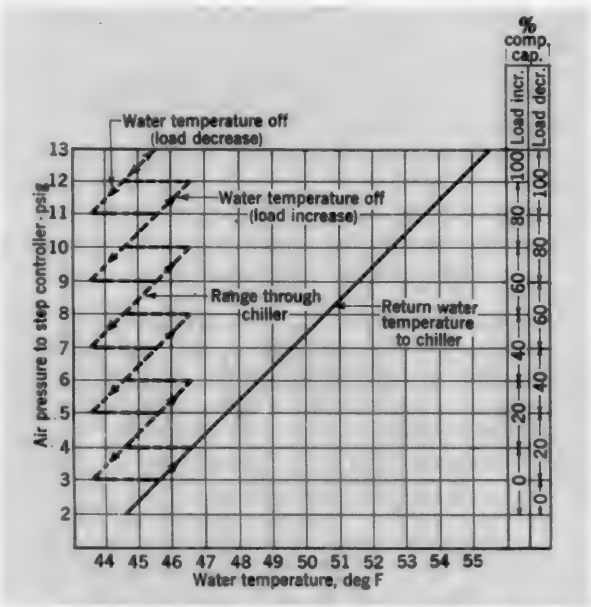


Fig. 12. Water temperature control — pneumatic step controller with bulb in return water to chiller.

energized, bleeding down the air operator, which will recycle the step controller to the fully off position. As the safety control or power failure again permits the circuit to become energized, the solenoid valve opens and bleeds air to the step controller motor. The time lag between steps of compressor capacity is provided by metering the air flow through the restrictor. After *EP-1* becomes energized, a time lag will occur before the first switch makes on the step controller *SC-1*, which will start the compressor. With the compressor started, *SC-1* also energizes the capacity reduction solenoid valves *CRS-2* and *CRS-1*, which bypass oil around the unloader mechanisms, holding the compressor at minimum capacity. If the thermostat calls for more cooling, the *SC-2* contact opens, de-energizing capacity reduction solenoid No. 2 (*CRS-2*), adding an additional step of capacity. The third step operates off of *SC-3*.

Figure 12 represents a typical water chilling application showing water temperatures on and off the chiller at various operating conditions, with a pneumatic thermostat operating a step controller, the bulb located in the return water line. The solid line represents the return water temperature from minimum to full load. The broken lines show what the leaving water temperature will be from the cooler for each return water temperature. Note that with the control set to provide 45 deg water off the chiller, the maximum variation from a design point is plus or minus 1½ deg. The overlap in leaving water temperatures, illustrated by the broken lines, is caused by the differential setting between make- and break cams of the step controller. The right-hand column shows the per cent capacity on the compressor for each temperature condition, both for increased and decreased loading conditions.

Application Of Electric Step Controllers

Electric motor driven step controllers may be either of two types, proportioning or floating control. Each requires a different type electric motor as well as a different type controller.

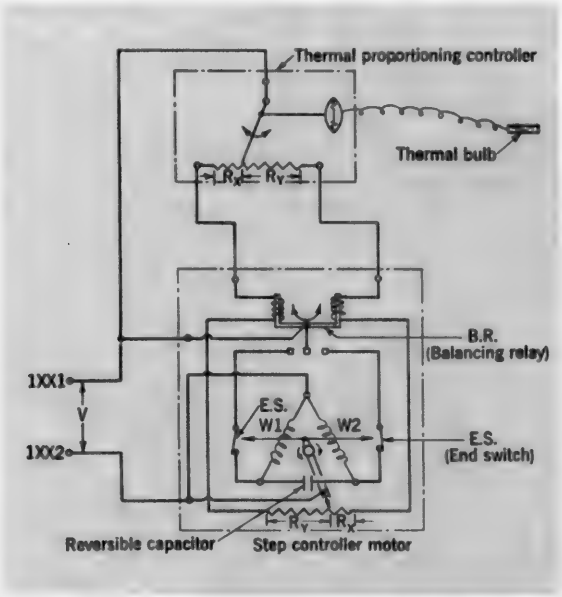


Fig. 13. Electric proportioning control.

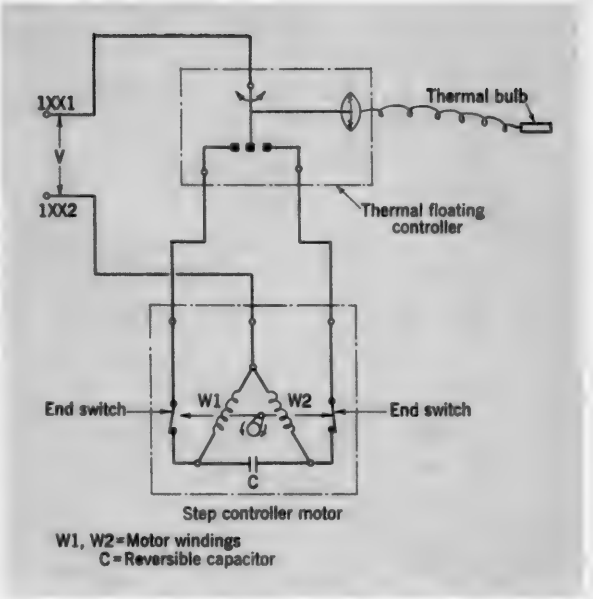


Fig. 14. Electric floating control.

As discussed previously, any proportioning type controller will provide a different output signal for each temperature measured. The electric proportioning type controller sends a variable signal to the step controller motor, depending upon the temperature or pressure measured by the controller.

Figure 13 shows a schematic wiring diagram which incorporates a proportioning type electric thermostat with an electric step controller motor. The thermostat will generally be the liquid filled capillary type, wherein the fluid in the bulb expands or contracts to exert pressure on a diaphragm which positions the electrical contact on a resistance circuit.

Electric current flows from the thermostat contact through both branches of the resistive circuit, through parallel circuits to the step controller motor. The latter contains a balancing relay which attempts to balance the current flowing through each of the two parallel circuits. If the thermostat calls for additional capacity, it will move the contact on the thermostat resistance bar in one direction, resulting in more current flow through one circuit than the other. This unbalances the balancing relay on the step controller motor, making contact with one side of the motor windings. This will then rotate the motor in the direction to increase compressor capacity. As the motor assumes a new position, a resistance circuit in the step controller control circuit will attempt to rebalance the current flow through the two parallel circuits. When it reaches a point where the current flow through both circuits of the thermostat become balanced with opposite resistances in the step controller circuit, the relay is in balance and neither circuit to the motor windings is energized.

A reversible capacitor may be used on the step controller motor circuit between windings to permit both sets of windings to be in operation. In this way, both sets of windings are available to rotate in either direc-

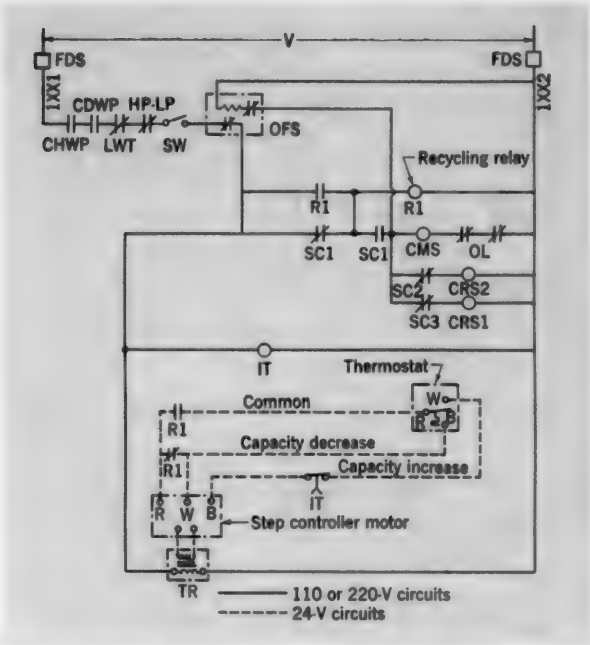


Fig. 15. Typical control wiring diagram — electric step controller with floating control.

tion and the duplicate windings then need not be provided.

End switches are contained within the step controller motor circuit to break the electrical circuit when the motor reaches the end of its travel, generally an arc of between 120 and 160 deg.

As with pneumatic proportioning type control, the writer's experience has been that for electric proportioning type control as well, the thermal bulb should be located in the return water line to the chiller to obtain the most favorable operation. The sequencing of capacity steps is similar to that of the proportioning type control. The thermostat would call for 100% compressor capacity when the return water temperature is 55 deg and zero capacity when it is 45 deg for an installation requiring a design temperature of 45 deg water off when cooled through a 10 deg range.

Another type of control used with the electric step controller is floating control as illustrated in Fig. 14. The term "floating control" means that the thermostat or pressure controller floats between two contact bars, increasing capacity with one contact, decreasing it with the other, or floating in between when the thermostat is satisfied. Most thermostats used for this type of duty on water chilling applications have a differential of approximately 3 deg, giving a tolerance of plus or minus 1½ deg from the desired water leaving temperature for this service.

For the arrangement shown on Fig. 14, an increase in water temperature off the cooler would move the thermostat diaphragm to the left making the electric circuit from *1XX1* through the left circuit to the step controller motor winding *W1*, and in parallel through the reversible capacitor to winding *W2*. This would rotate the motor to increase compressor capacity. When the thermostat is satisfied, the diaphragm would move to the right and float between contacts until a further change in capacity is required. End switches are also provided on this type of step controller motor to limit the motor travel at the extremities of the arc.

Since the floating type controller only changes capacity until it becomes satisfied, there is no relationship between the thermostat and the step controller motor position. Consequently, the thermostat bulb must be located on the water leaving side of the chiller where it can call for either additional capacity or reduced capacity if the temperature variation exceeds approximately 1½ deg variation from the design setting.

In applying proportioning type control to air conditioning and refrigeration systems, it has been found through experience that the floating controller responds too rapidly for the compression system to balance with the evaporator load without undue cycling. For this reason, a timer should be incorporated in the control circuit to provide some time lag between action of the thermostat and response by the compression system. This permits the system to stabilize itself without continually attempting to cycle back and forth between increments of capacity.

Figure 15 shows a typical control wiring diagram utilizing the electric type step controller with floating control. This arrangement incorporates a recycling relay arranged in such a manner that the compressor or compressors will always start at minimum capacity following a shutdown for any reason.

After the compressor has gone off the line, the circuit to relay *R1* becomes de-energized and cannot again be energized until the step controller moves to the completely unloaded position. It can again become energized only by the first mercury bulb or microswitch which closes only at the beginning of the cycle. If the step controller motor is at 100% capacity or any intermediate point when current interruption results, de-energizing relay *R1* will make electrical circuit from *R* to *W* on the step controller motor, moving it to the unloaded position. As the motor reaches the end of its stroke, *SC1* makes contact to recycling relay *R1*. If the current interruption through the various safety switches has corrected itself, relay *R1* becomes energized, pulling in a holding contact which keeps it energized until current interruption again occurs. The electrical circuit from the step controller motor to the thermostat now has normally closed relay contact *R1* opened and the normally open contact will be closed. The thermostat is then connected to the step controller motor for normal operation, so that if its temperature is not satisfied, it will move the step controller motor to increase compressor capacity. As the step controller rotates, *SC1* reverses in position so the normally open contact closes and starts the compressor motor. This same circuit also provides electric current to the heater circuit of the oil failure switch and to the other step controller switches which regulate the individual solenoid valves. A further increase in thermostat requirements will rotate the motor shaft to break additional step controller switches to add compressor capacity. Where the inrush and/or sealed circuit current exceeds the rating of any contacts, separate relays should be used.

FOREIGN SUMMER DESIGN TEMPERATURES

Concluded from last month. Reproduced by permission from *A Guide to Current Practice, 1959*, The Institution of Heating and Ventilating Engineers, Great Britain, and based on information from the Meteorological Office of the Air Ministry, London. To be used only when more detailed investigation of local climatic conditions is not feasible.

Country and City	Ground Elevation, Ft.	Design Month	Design Temp. deg. F		Av Diurnal Range, deg. F
			Dry Bulb	Wet Bulb	
Burma					
Akyab	29	Apr	95	*	15
Mandalay	252	May	106	*	19
Mergui	66	Apr	95	*	16
Rangoon	18	Apr	102	*	21
Ceylon					
Colombo	24	Feb	92	80	15
Trincomalee	24	May, Sept	96	82	13
China					
Shanghai	23	July	98	83	16
Tientsin	13	July	101	82	17
Hongkong					
Hongkong	109	July, Aug	91	82	9
India					
Allahabad	322	June	115	*	20
Bangalore	3021	Apr	99	*	24
Bombay	37	June	93	*	10
Calcutta	21	May	103	*	19
Hyderabad	1778	May	109	*	14
Madras	51	May	107	*	19
New Delhi	714	June	111	*	19
		July	104	*	15
Indonesia					
Balikpapan	23	Jan	90	80	12
Batavia (Jakarta)	26	Oct	92	79	13
Padang	22	Feb, Mar	91	79	13
Iraq					
Baghdad	111	Aug	117	75	34
Basra	8	July	114	84	23
Mōsul	730	July	116	76	37
Israel					
Eilat	7	Aug	111	78	25
Haifa	33	May	100	78	18
		Aug	93	83	14
Jerusalem	2485	June	97	70	25
Japan					
Hiroshima	100	Aug	94	79	16
Nagasaki	436	July	92	80	12
Osaka	10	Aug	95	80	16
Sapporo	56	Aug	89	75	18
Tōkyō	19	Aug	92	79	14
Jordan					
Ammān	2548	Aug	100	72	25
Kashmir					
Srinagar	5205	July	96	*	23
Korea					
Seoul (Kyŏngsŏng)	285	Aug	95	79	16
Lebanon					
Beirūt	111	Aug	92	78	15
Malaya					
Kula Lumpur	127	May	95	83	17
Penang	17	Mar	94	82	18
Singapore	33	May	92	83	14
Manchuria					
Mukden	141	July	95	78	18
North Vietnam					
Hanoi	53	June	100	86	14
Pakistan					
Chittagong	87	Apr	94	*	16
Karachi	13	May	102	86	14
Lahore	702	June	115	78	27
		July	109	86	20
Narayanganj (near Dacca)	26	May	96	*	15
Quetta	5490	July	101	73	30
Persia (Iran)					
Isfahān	5817	July	103	69	31
Meshed	3104	July	99	*	29
Tehran	4001	July	104	*	27
Philippines					
Manila	47	May	97	83	18
Siam (Thailand)					
Bangkok	7	Apr	101	84	18
South Vietnam					
Saigon	30	Apr	98	84	19
Syria					
Esh Shām (Damascus)	2362	Aug	105	73	35
Turkey					
Ankara	2825	July	96	69	27
Izmir (Smyrna)	92	Aug	101	76	23
U.S.S.R. (Asian)					
Vladivostok	94	July	85	72	11

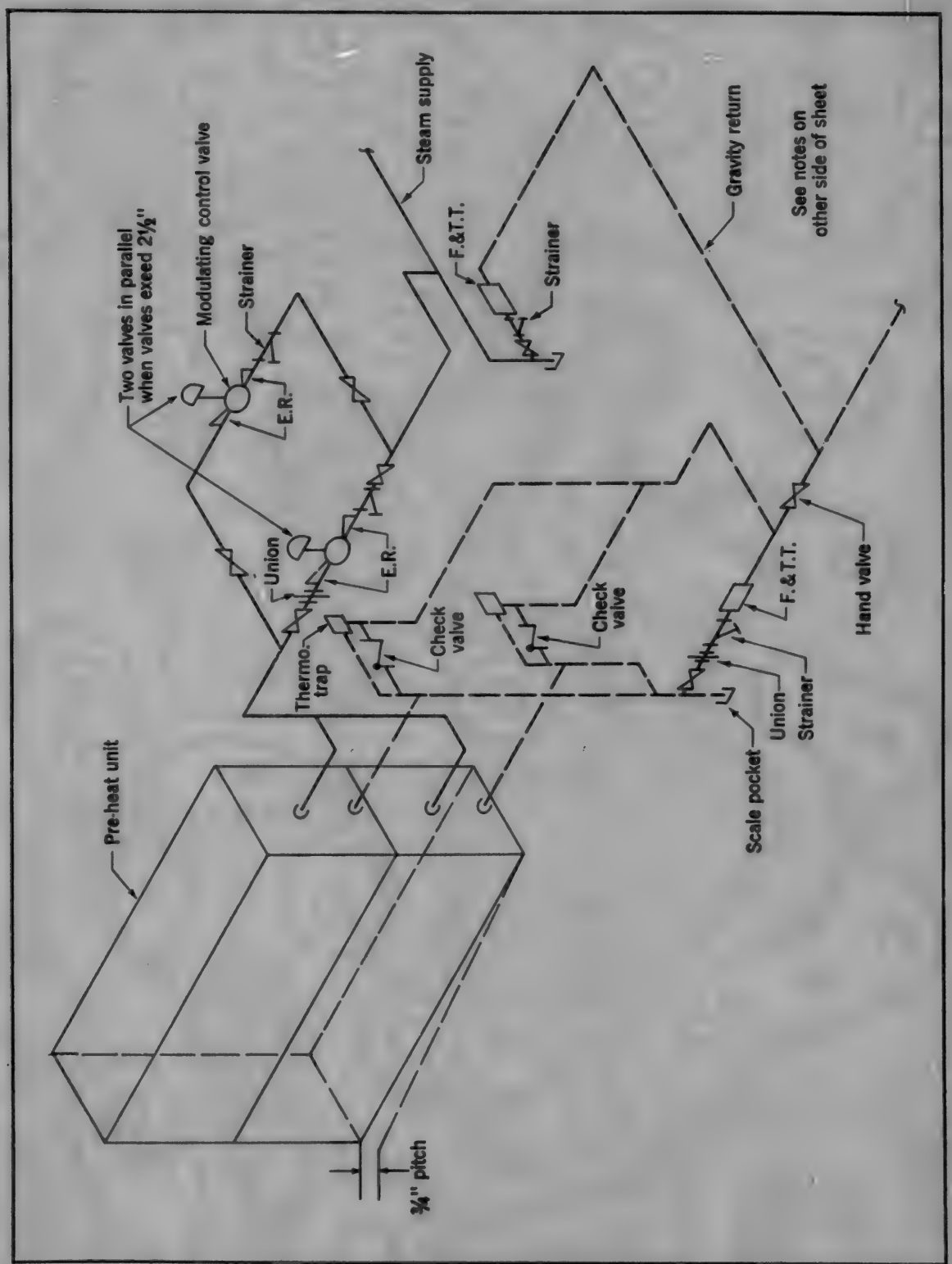
* No suitable data available on which to base design wet bulb.

Country and City	Ground Elevation, Ft.	Design Month	Design Temp. deg. F		Av Diurnal Range, deg. F
			Dry Bulb	Wet Bulb	
Australasia					
Australia					
Adelaide	140	Jan	108	74	24
Albany	41	Feb	91	72	15
Brisbane	137	Dec	96	77	18
Canberra	1837	Jan	97	70	27
Cloncurry	633	Jan	108	77	22
Hobart	177	Jan	91	68	18
Kalgoorlie	1247	Jan	108	74	29
Launceston	253	Feb	89	69	24
Melbourne	115	Jan	102	74	21
Perth	197	Jan	102	75	22
Port Darwin	97	Nov	98	83	16
Sydney	138	Jan	95	75	13
Townsville	48	Feb	94	81	12
New Guinea					
Port Moresby	126	Dec	94	83	14
New Zealand					
Auckland	85	Jan	79	67	13
Christchurch	32	Jan	86	67	17
Dunedin	240	Jan	82	66	16
Wellington	415	Feb	78	67	13
Pacific Ocean					
Fiji Is. (Suva)	20	Feb, Mar	91	81	12
Gilbert Is. (Tarawa)	9	Dec	92	82	10
New Britain (Rabaul)	41	Nov	95	84	18
New Caledonia (Noumea)	30	Jan	93	80	14
South America					
Argentina					
Bahia Blanca	95	Jan	102	76	26
Buenos Aires	89	Jan	97	79	22
Cordoba	1388	Jan	104	78	27
Mendoza	2625	Jan	102	77	30
Bolivia					
La Paz	12001	Nov	74	58	25
Brazil					
Belem (Para)	42	Nov	93	86	19
Manaos	144	Oct	96	81	16
Rio de Janeiro	201	Jan	94	79	11
Santos	10	Jan	97	81	12
British Guiana					
Georgetown	6	Sept, Oct	89	79	11
British Honduras					
Belize	17	Oct	90	84	14
Chile					
Antofagasta	308	Jan	80	71	13
Santiago	1706	Jan	92	70	32
Valparaiso	135	Feb	81	68	16
Colombia					
Bogota	8678	Mar	73	60	17
Ecuador					
Quito	9446	Sept	80	63	28
Guatemala					
Guatemala	4855	May	87	73	24
Paraguay					
Asuncion	456	Jan	103	84	24
Peru					
Lima	394	Feb	88	76	16
Venezuela					
Maracaibo	20	Aug, Sept	98	84	17
West Indies					
Barbados					
Bridgetown	181	Sept	89	81	13
Bermuda					
Hamilton	151	Aug	90	79	12
Cuba					
Havana	80	Sept	92	80	13
Dominica					
Roseau	60	May	94	80	19
Haiti					
Port-au-Prince	121	July	98	78	20
Jamaica					
Kingston	110	Aug	93	83	17
St. Kitts					
La Guerite	157	Sept	88	80	10
Trinidad					
Port of Spain	72	May	93	79	19

(The table is concluded)

STEAM HEATED COIL

Hookup for Pre-heat Coil in Fan Room

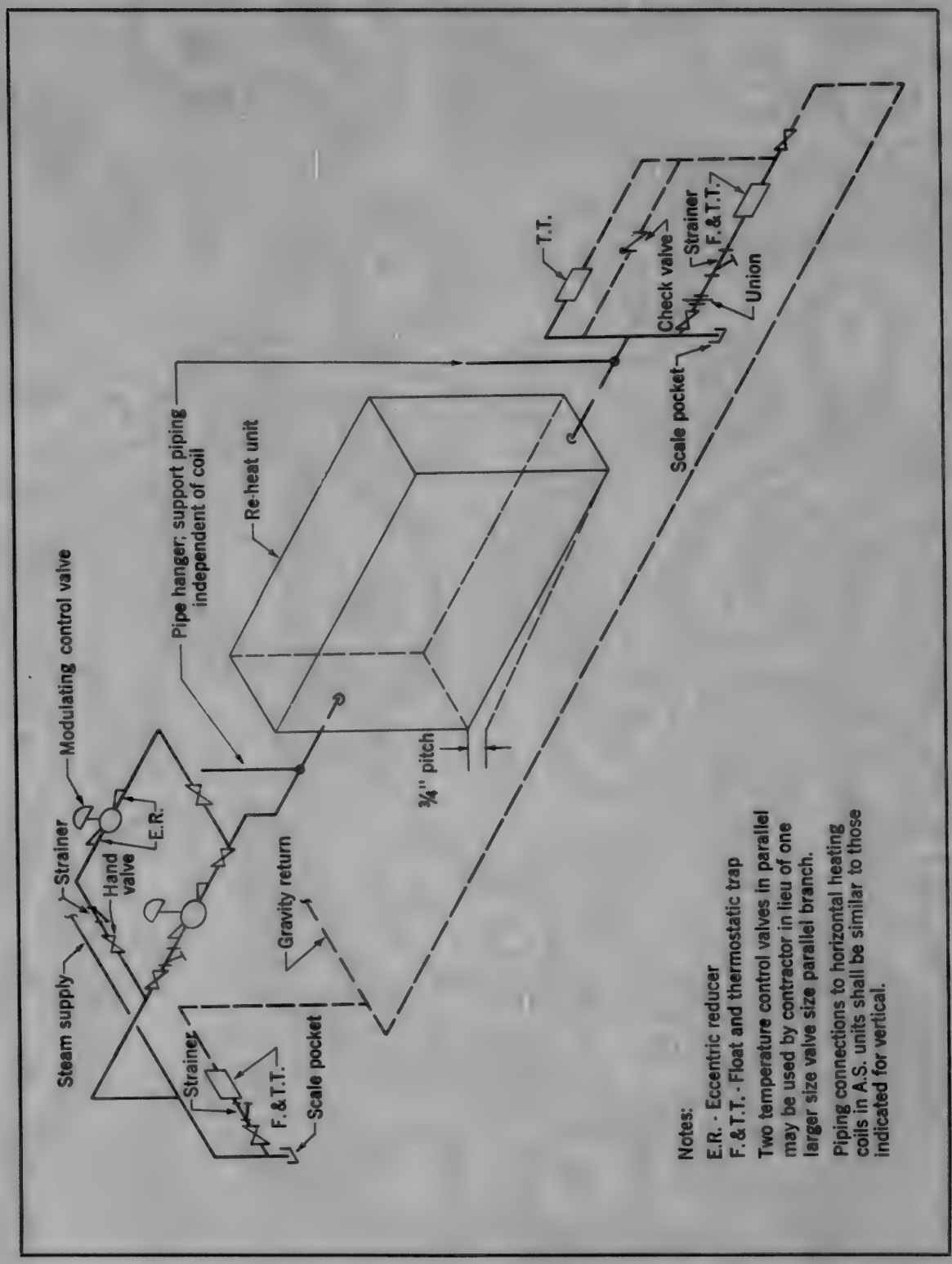


DETAIL SHEET—AIR CONDITIONING, HEATING AND VENTILATING

February, 1961

STEAM HEATED COIL

Hookup for Re-heat Coil in Fan Room



DETAIL SHEET—AIR CONDITIONING, HEATING AND VENTILATING

February, 1961

How to Evaluate

Performance of Air Conditioners At Off-Design Conditions—Part 2

HIDEO SUENAGA and TAKASHI OTAKI
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Concluded from last month, the article describes a new method by which the performance of an air conditioner over a wide range of entering air conditions can be predicted. The symbols were defined in Part 1.

The Coil Characteristic, K

Factors that influence the value of the coil characteristic, K are: air weight flow rate, G; heat coil resistance, R; contact factor, and coil surface area, A_o. For a given air conditioner, the coil surface area A_o remains constant.

G varies according to the inlet air conditions, fan speed and coil air resistance. In Fig. 8 weight flow is plotted against inlet air wet bulb temperature for a given air conditioner fan speed.

The coil heat resistance, overall heat resistance minus air side heat resistance, includes refrigerant side heat resistance, fin metal resistance, and resistance due to the condensed water film. In Fig. 9 coil heat resistance, R; coil heat flux, q, in kilocalories per square meter per hr; and refrigerant flow rate G_r, in kilograms per hour; for various inlet air wet bulb temperatures are shown. The circular dots are experimental values; the solid lines indicate the computed value.

In computing the refrigerant side heat transfer coefficient of Refrigerant 12 (CCl_2F_2), the following relation was used:[3]

$$h_1 = 0.0235 \frac{(G_r\, q)^{1/2}}{d},$$

Kcal per (hr)(sq m) (deg C) (7)

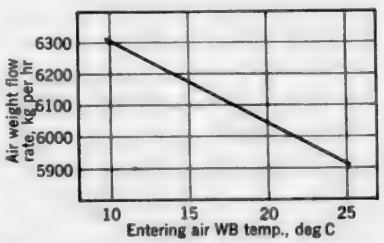

Fig. 8. Air weight flow rate varies according to inlet air conditions.

All calculated values of R lie below the experimental values. This is because the authors used the lower refrigerant temperatures, rather than the actual, and neglected superheat effect and condensate film resistance, which is negligible.

Contact factor depends on the value of G and air side heat transfer coefficient, h_3. Air side heat transfer coefficients are obtained from the experimental by-pass (BF) factors of a four-row coil using the relation

$$BF = \exp\,(-h_3\, A_o / G\, C_p)$$

The air side heat transfer coefficients, h_3, thus obtained are used to determine Nusselt numbers. The Nusselt numbers are plotted against the Reynolds numbers based on the maximum air velocity through the minimum net opening area at the coil face (not face velocity). The solid line on Fig. 10

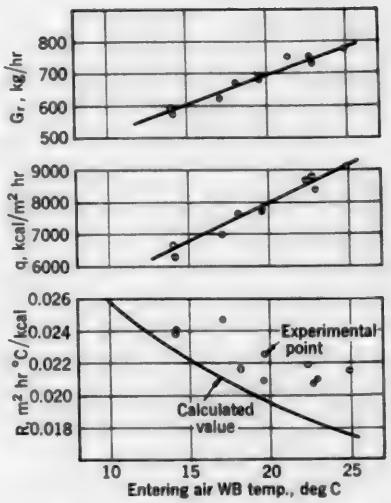

Fig. 9. R, q, and G_r vs. entering wet bulb temperature.

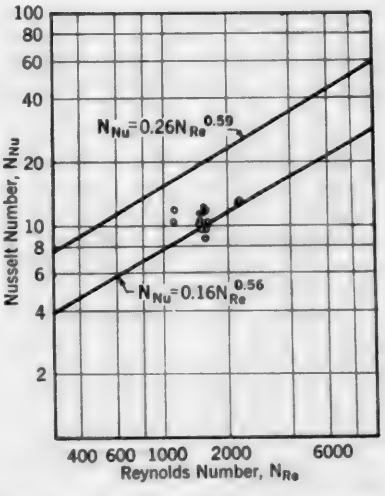

Fig. 10. N_{Nu} vs. N_{Re} based on maximum air velocity through the minimum net opening area at coil face.

compares the experimental Nusselt number and that computed from Holladay's equation:[5]

$$Nu = 0.18\ (N_{Re})^{0.56}\ (N_{Pr})^{0.33}$$

$$= 0.16\ (N_{Re})^{0.56} \text{ if } N_{Pr} = 0.71$$

Also in Fig. 10 (upper curve) is the relation suggested by Aoki[4].

Air side coefficients obtained by the experiments at $N_{Re} = 1500$ are also plotted against the sensible heat ratio as indicated in Fig. 11. It is interesting to note that the air side coefficient decreases as the sensible heat factor increases. This phenomena may be explained by the effect caused by the condensed water film or droplets on the coil surface. The condensed water film may restrict the air flow passage, thus causing the higher air velocity, which in turn increases the air side coefficient; or, the condensed water droplets may actually increase the heat transfer surface, or may act as a turbulating medium, which also increases h_s. Using the relations depicted in Fig. 7, 8 and 11, the contact factors of the air conditioner are found to lie in the zone illustrated in Fig. 12.

Fig. 13 shows the zone of coil characteristics, K, as a function of the wet bulb temperature entering the air conditioner.

Predicting Performance

Once accurate values of K at a given inlet condition, and the system low side refrigerant pressure drop are established, it is possible to predict air conditioner performance with a reasonable accuracy by adjusting K, G and CF, depending upon the entering wet bulb.

By using the surface temperature sheet, including condensing capacity curves, such as shown in Fig. 4, very accurate values of t_s and K can now be predicted, in spite of the fact that the value of K varies considerably.

If the estimated value of K is smaller than the true K, the balance line XY in Fig. 4 moves toward the higher value of t_r and vice versa, thus yielding the accurate value of t_s. For instance, if air enters the coil at 27 deg C (80.6 deg F) and 50% rh, and $CF = 0.8$, the values of t_s are 13.1

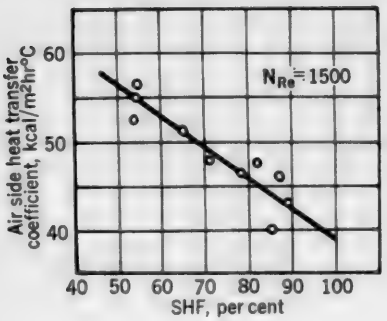

Fig. 11. Relation between the sensible heat factor and the air side heat transfer coefficient.

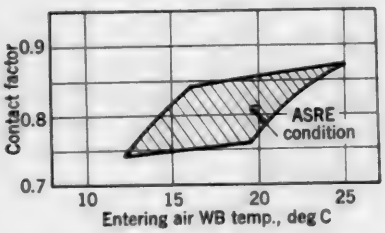

Fig. 12. Coil contact factor zone as a function of entering air wet bulb temperature.

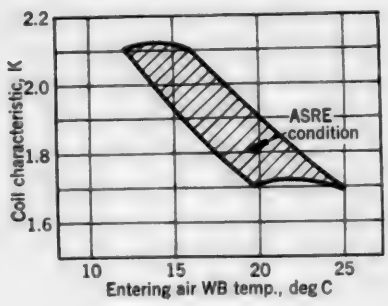

Fig. 13. The coil characteristic zone plotted against entering air wet bulb temperature.

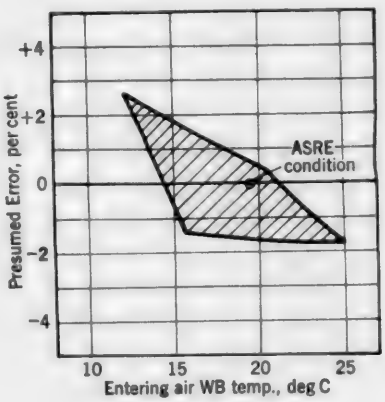

Fig. 14. Extent of error in calculated cooling capacity of air conditioner, as a function of entering wet bulb temperature, using the method developed in this article.

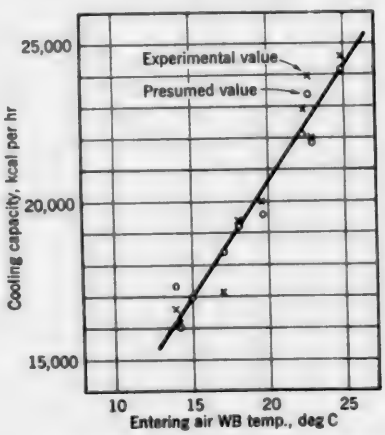

Fig. 15. Cooling capacity of the experimental air conditioner compared to calculated capacity, as a function of entering air wet bulb temperature.

COMPUTATIONS AND SPECIFICATIONS FOR EXPERIMENTAL AIR CONDITIONER

(Authors' work sheets)

TABLE 1 - COMPUTED PERFORMANCE, NEGLECTING FAN REHEAT EFFECT

TEST NO.			14	15	16	17	18	19	20	21	22	23
Entering air condition	DB	°C	26.8	26.8	27.1	26.8	26.7	20.2	20.4	21.1	29.7	29.9
		°F	80.2	80.2	80.8	80.2	80.0	68.4	68.7	70.0	85.5	85.8
	WB	°C	19.6	19.6	22.9	22.7	18.1	14.0	14.1	17.1	24.9	22.3
		°F	67.3	67.3	73.2	72.9	64.6	57.2	57.4	62.8	76.8	72.2
Air weight flow rate		kg/hr	6275	6160	6050	6240	5980	6040	6030	5910	5960	6000
		lb/hr	13840	13580	13340	13760	13180	13320	13300	13030	13140	13230
Refrigerant superheat, measured		°C	8.5	5.8	10.2	10.6	7.1	3.0	2.4	5.7	11.5	9.9
		°F	15.3	10.4	18.4	19.1	12.8	5.4	4.3	10.3	20.7	17.8
Refrigerant subcooling, measured		°C	10.8	10.7	11.0	5.0	9.6	11.6	13.4	12.7	9.7	9.5
		°F	19.5	19.3	19.8	9.0	17.1	20.9	24.1	22.9	17.5	17.1
Coil characteristic, K		°C-kg/kcal	2.15	1.96	2.08	2.12	1.93	2.13	2.08	2.34	2.06	2.03
		°F-lb/Btu										
Cooling capacity, measured (x 100 kcal/hr, Btu/hr)	a*	kcal/hr	2.05	2.06	2.26	2.46	2.00	1.72	1.69	1.77	2.52	2.36
		Btu/hr	8.14	8.18	8.97	9.76	7.94	6.83	6.71	7.03	10.00	9.37
	b*	kcal/hr	2.07	2.08	2.24	2.36	2.04	1.77	1.68	1.87	2.43	2.32
		Btu/hr	8.22	8.26	8.89	9.37	8.02	7.02	6.67	7.42	9.64	9.21
Error (a-b)/a		%	-1.0	-1.0	+0.9	+4.1	-2.0	-2.9	+0.6	-5.7	+3.6	+1.7
Cooling cap., computed, C (x 100 kcal/hr, Btu/hr)		kcal/hr	1.96	1.96	2.18	2.36	1.93	1.71	1.61	1.83	2.42	2.20
		Btu/hr	7.78	7.78	8.65	9.37	7.66	6.79	6.39	7.26	9.61	8.73
Error	(a-c)a	%	-4.4	-4.9	-3.5	-4.1	-3.5	-0.6	-4.7	+3.4	-4.0	-6.7
	(b-c)b	%	-5.3	-5.8	-2.7	0	-5.4	-3.4	-4.2	-2.1	-0.4	-5.2
Sensible heat factor, %	measured		82	78	55	54	87	89	85	65	54	71
	computed		80	80	54	53	90	85	90	65	53	72
	error		-2.4	+2.6	-1.8	-1.9	+3.5	-4.5	+5.9	0	-1.9	+1.4
Evaporating temperature	measured	°C	1.5	1.9	4.3	4.2	-0.6	-3.0	-2.0	0	5.3	3.2
		°F	34.7	35.4	39.7	39.6	30.9	26.6	28.4	32.0	41.5	37.8
	computed	°C	2.1	2.1	4.7	3.3	0.2	-2.9	-1.9	0.3	5.7	3.6
		°F	35.8	35.8	40.5	37.9	32.4	26.8	28.6	32.5	42.3	38.5
	error	°C	+0.6	0	+0.4	-0.9	+0.8	+0.1	+0.1	+0.3	+0.4	+0.4
Coil surface temp.	measured	°C	13.9	13.7	17.7	17.0	11.9	7.7	8.0	11.7	19.4	16.3
		°F	57.0	56.7	63.9	62.6	53.4	45.9	46.4	53.1	66.9	61.3
	computed	°C	13.9	13.9	17.5	16.8	12.1	7.9	8.5	11.4	19.4	16.7
		°F	57.0	57.0	63.5	62.2	53.8	46.2	47.3	52.5	66.9	62.1
	error	°C	0	+0.2	-0.2	+0.2	+0.3	+0.2	+0.5	-0.3	0	+0.4

Notes: 1. Computation based on the following values: K=2.15, CF=0.81, G=6040 at 5°C (9°F) refrigerant superheat and 5°C (9°F) subcooling.
2. a*-from air side; b*-from condenser side.

TABLE 2 - COMPUTED PERFORMANCE, INCLUDING FAN REHEAT EFFECT

TEST NO.			14	15	16	17	18	19	20	21	22	23
Coil characteristic, K		°C-kg/kcal	2.09	1.82	1.85	1.96	1.87	2.05	2.04	2.07	2.13	1.91
		°F-lb/Btu										
Cooling capacity, measured (x 100 kcal/hr, Btu/hr)	a*	kcal/hr	1.99	2.00	2.20	2.40	1.93	1.66	1.62	1.71	2.46	2.30
		Btu/hr	7.90	7.94	8.73	9.53	7.66	6.59	6.43	6.79	9.76	9.13
	b*	kcal/hr	2.00	2.02	2.17	2.29	1.98	1.70	1.62	1.80	2.37	2.26
		Btu/hr	7.94	8.02	8.61	9.09	7.86	6.75	6.43	7.14	9.40	8.97
Error (a-b)/a		%	-0.5	-1.0	+1.3	+4.6	-2.6	-2.5	0	-5.2	+3.7	+1.7
Cooling cap., computed, C (x 100 kcal/hr, Btu/hr)		kcal/hr	1.96	1.96	2.19	2.34	1.93	1.73	1.61	1.84	2.42	2.21
		Btu/hr	7.78	7.78	8.69	9.29	7.66	6.87	6.39	7.30	9.61	8.77
Error	(a-c)a	%	-1.5	-2.0	-0.5	-2.5	0	+4.2	-0.6	+7.6	-1.6	-3.9
	(b-c)b	%	-2.0	-3.0	+0.8	+2.2	-2.5	+1.8	-0.6	+2.2	+2.1	-2.2
Sensible heat factor, %	measured		77	77	54	53	88	84	85	65	52	68
	computed		77	77	53	52	84	84	85	63	52	70
	error		0	0	-1.9	-1.9	-4.6	0	0	-3.1	0	+2.9
Evaporating temperature	measured	°C	1.5	1.9	4.3	4.2	-0.6	-3.0	-2.0	0	5.3	3.2
		°F	34.7	35.4	39.7	39.6	30.9	26.6	28.4	32.0	41.5	37.8
	computed	°C	2.1	2.1	4.9	3.6	0.5	-2.6	-1.9	0.4	5.9	3.8
		°F	35.8	35.8	40.8	38.5	32.9	27.3	28.6	32.7	42.6	38.8
	error	°C	+0.6	+0.2	+0.6	-0.6	+1.1	+0.4	+0.1	+0.4	+0.6	+0.6
Coil surface temp.	measured	°C	13.5	13.4	17.4	16.6	11.9	7.5	7.5	11.3	19.0	15.9
		°F	56.3	56.1	63.3	61.9	53.4	45.5	45.5	52.3	66.2	60.6
	computed	°C	13.5	13.5	17.0	16.4	11.7	7.6	8.0	11.0	18.9	16.3
		°F	56.3	56.3	62.6	61.5	53.1	45.7	46.4	51.8	66.0	61.3
	error	°C	0	+0.1	-0.4	-0.2	-0.2	+0.1	+0.5	-0.3	-0.1	+0.4

Notes: 1. Computation based on the following values: K=1.91, CF=0.76, G=6040 at 5°C (9°F) refrigerant superheat and 5°C (9°F) subcooling.
2. Entering air is the same condition as in Table 1.
3. a*-from air side; b*-from condenser side.

TABLE 3 - COMPUTED PERFORMANCE AT VARIOUS AIR FLOW RATES

24	25	26	27
27.2	27.3	27.7	27.3
81.0	81.1	81.9	81.1
20.0	20.0	18.9	22.7
68.0	68.0	66.0	72.8
8860	8860	4425	4385
19540	19540	9760	9670
11.9	9.4	4.2	10.4
21.4	16.9	7.6	18.7
11.9	11.2	10.0	11.3
21.4	20.2	18.0	20.3
3.33	2.71	1.85	2.05
2.19	2.19	1.87	2.18
8.69	8.69	7.42	8.67
2.24	2.14	1.84	2.27
8.89	8.50	7.30	9.01
-2.3	+2.3	+1.6	-4.0
2.16	2.04	1.97	2.13
8.57	8.10	7.82	8.46
-1.4	-6.9	+5.3	-2.4
-3.6	-4.7	+7.1	-6.2
88	90	83	54
87	90	80	52
-1.1	0	-3.6	-3.7
1.7	3.5	-0.4	2.7
35.1	38.3	31.3	36.9
3.8	6.5	0.3	3.8
38.8	40.1	32.9	38.8
+2.1	+1.0	+0.9	+1.1
15.7	13.7	12.0	16.1
60.3	60.3	53.6	61.0
15.5	15.7	11.0	13.4
59.9	60.3	51.8	59.7
-0.2	0	-1.0	-0.7

Notes: 1. Computations for tests 24 and 25 are based on K=2.47, CF=0.74, G=8860; for tests 26 and 27, K=1.36, CF=0.84, and G=4400.

2. Refrigerant superheat and subcooling are both assumed to be 5°C (9°F) for all tests.

3. a*-from air side; b*-from condenser side.

TABLE 4 - SPECIFICATIONS OF EXPERIMENTAL COIL

Type		Plate-Fin
Number of rows		4
Number of Tube circuits		12
Height, mm (ft)		596 (1.95)
Width, mm (ft)		1050 (3.45)
Depth, mm (ft)		154 (0.51)
Face area, m² (ft²)		0.626 (6.76)
FIN	Material	Aluminum
	Thickness, mm (in)	0.40 (0.016)
	Pitch, mm	3.2 (8Fin/in)
	Number of sheets	327
TUBE	Material	Copper
	Wall thickness, mm (in)	1.2 (0.47)
	Outside diameter, mm (in)	15.9 (5/8)
	Total number of tubes	60
Total outside area a, m² (ft²)		5.32 (57.3)
Total inside area b, m² (ft²)		2.67 (28.8)
Coil surface ratio, a/b		20.0

deg C (55.6 deg F), 13.3 deg C (55.9 deg F), 13.5 deg C (56.3 deg F), 13.6 deg C (56.5 deg F), 13.7 deg C (56.7 deg F) corresponding respectively to K = 2.5, 2.25, 2.0, 1.75 and 1.5.

Now, the values of K, CF, and G are chosen at the inlet air condition specified by ASRE Standard 210-58 at 26.7 deg C dry bulb (80 deg F dry bulb), 19.4 deg C wet bulb (67 deg F wet bulb). Coil total capacity, sensible heat factor, refrigerant temperature, t_r and coil surface temperature, t_s are computed for all possible values of K indicated in Fig. 13 based upon K, CF, and G at the ASRE standard inlet conditions. Deviation of the total capacity due to the variation of K is $\pm$ 3%; sensible heat factor, $\pm$ 0.02; t_s, $\pm$ 0.3 deg C (0.5 deg F); and t_r $\pm$ 1.3 deg C (2.5 F).

This is very encouraging, because the variations of K, G and CF, which depend upon entering air conditions, do not influence the coil performance computation more than the aforementioned deviations. See Fig. 14.

If fan heat is added to the computed coil performance, the following corrections are necessary:

The coil surface temperature (or ADP) decreases 0.1-0.5 deg C (0.2-0.9 deg F) due to the added sensible heat. Leaving air dry bulb increases 0.3-0.5 deg C (0.5-0.9 deg F). Contact factor increases 0.03-0.07. Sensible heat factor decreases 0.01-0.02. Therefore, fan heat has a very minor effect.

Experimental Check

Table 1 is a record of the test conditions and performances of an air conditioner. The imposed superheat is 5 deg C (9 deg F), the subcooling, 5 deg C (9 deg F). The computed values in Table 1 are based on the average K and CF of the overall experimental points, and evaporator temperature is assumed 3.5 deg C (6.3 deg F) higher than the saturated suction compressor inlet temperature. Fan heat is neglected. Table 2 is a record of the same data with fan heat taken into consideration in computing performance.

The 3.5 deg C (6.3 deg F) difference between the evaporating temperature and the saturation suction compressor temperature is determined from the equivalent temperature value corresponding to the sum of the measured coil pressure drop, 0.1 kg per sq cm (1.4 psi), and suction line pressure drop, 0.3 Kg per sq cm (4.3 psi). This is rather too high, giving a balanced refrigerant temperature and condensing unit capacity that is too low. In this experiment, the cooling capacity obtained from the air side and condenser side agree within 6%, which satisfies ASRE Standard 16-56.

Fig. 15 illustrates the cooling capacity of the test air conditioner as related to the entering air wet bulb temperature. The unit cooling capacity almost linearly increases as the entering wet bulb temperature increases.

Table 3 illustrates the unit performance when the air volume flow is varied. The computed performance also shows very good agreement. In this computation, the authors used

$$N_{Nu} = 0.16\, N_{Re}^{0.66}$$

for the air side heat transfer coefficient, and equation (7) for the refrigerant side heat transfer coefficient based on the experimental average

G_r = 700 Kg per hr (1410 lb/hr)

and

q = 7,500 Kcal per (sq meter) (hr) (2760 Btu per (hr) (sq ft)

Table 3 indicates that the air flow rate influences the cooling capacity very little. If air flow rate is increased 1.4 times, the resulting cooling capacity increases only 5%. If air flow rate is reduced to 70%, capacity reduction is only 3%.

Table 4 gives coil construction and dimensions.

Limitation of the Method

(1) The method applies only when the sensible heat factor is less than unity. (2) Water cooling coils are not conveniently analyzed by this method. (3) Assumptions as stated in (Part 1), "Conditioner Coil Analysis," must be met. (4) The capillary tube expansion system is not covered by this analysis. (5) Further modification of the analysis is necessary to apply it to an air-cooled air conditioner. (6) When entering air relative humidity is exceedingly high, the error increases.

Conclusions

Air conditioner testing equipment, test results, and a new method of predicting unit performance have been presented. In conclusion, it can be stated that:

(1) The method of predicting coil surface temperature (or ADP) using the coil characteristic K and *STDL* introduced by T. Kusuda has been verified by these experiments. The method is very useful in predicting air conditioner performance.

(2) Condensing unit capacity curves have been applied to the Kusuda surface temperature chart. As a result, one can now find the balance point of the coil and condensing unit on a single psychrometric chart.

(3) Various factors influencing air conditioning unit performance were individually analyzed and tested. The authors found that those factors, determined at a given entering air condition, can be applied to all other entering air conditions within a small error in predicting performance.

(4) The limits of application of the method have been determined.

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CONTROL OF FUME

from Electric Steel Melting Furnaces

R. T. PRING

In this conclusion of a 2-part article, various fume control arrangements are assessed, ventilation rates computed, and gas cleaning methods and equipment are described.

Shell Evacuation: The range of applicability of direct shell evacuation of electric steel furnaces is the subject of current research. For large (15-ft diameter and upward) furnaces melting "open hearth" grade steel, shell evacuation, in conjunction with sensitive furnace pressure control, has been successful. There are at least three operating installations employing this principle in conjunction with water spray cooling of the hot furnace gases. In another installation, in which two 10-ft diameter furnaces are ventilated by shell evacuation, certain undesirable metallurgical side effects have become apparent. These include chilling of the slag, excessive oxidation during the refining period, and excessive electrode consumption. Still another installation involving a single 8-ft diameter furnace has not operated long enough to provide reliable information.

Significant research is under way at the McKeesport, Pennsylvania plant of Firth Sterling, Inc. under the joint sponsorship of several electric furnace steel producers in Allegheny County, Pennsylvania. Figure 11 is a diagram of the test installation. As a result of this test program, the operators have concluded that shell evacuation is entirely feasible in connection with smaller 9-ft furnaces even when special alloys are produced by the double slag process. It is probable, however, that electrode consumption is increased.

Total Air Volume

On the premise that, for adequate but not excessive furnace ventilation by shell evacuation, the quantity of hot gases withdrawn is comparable to that emitted from the furnace when equipped with a roof-mounted exhaust hood, it may be concluded that the total air volume, when tempering air is employed for gas cooling, is roughly the same for each ventilation method. Tempering air cooling appears most feasible in the ventilation of smaller furnaces; for large installations, the economy in gas volume to be treated greatly favors water spray cooling.

Balanced against the desirable compactness and convenience of the shell evacuation method are: (1) possible metallurgical side effects, (2) probable increase in electrode consumption (smaller furnaces), (3) need for sensitive furnace pressure controls, and (4) the need for controlled auxiliary gas cooling.

Table 7 compares each of the available methods of electric steel furnace ventilation.

Determination of Ventilation Rates

The selection of the proper ventilation capacity will insure the following:

(1) Adequate control of the furnace fume and gases at the source.

(2) Protection of the roof-mounted hood from damage due to overheating.

(3) Cooling the gases and ventilation air to the proper temperature for subsequent handling.

With the roof-mounted hood, particularly the type which encompasses the entire roof area, a ventilation capacity adequate to control the furnace emissions is usually sufficient to prevent heat damage to the hood and to provide a final gas temperature suitable for convenient handling of the exhaust gases. With the smaller, close fitting, roof-mounted hood, this is not necessarily the case, but further operating experience is desirable before conclusions may be drawn. In all cases of direct shell evacuation, auxiliary gas cooling is required, and the primary ventilation rate is a function of and is affected by the degree of pressure control required within the furnace.

No reliable method is known for estimating the actual volume of incandescent gases emitted from an

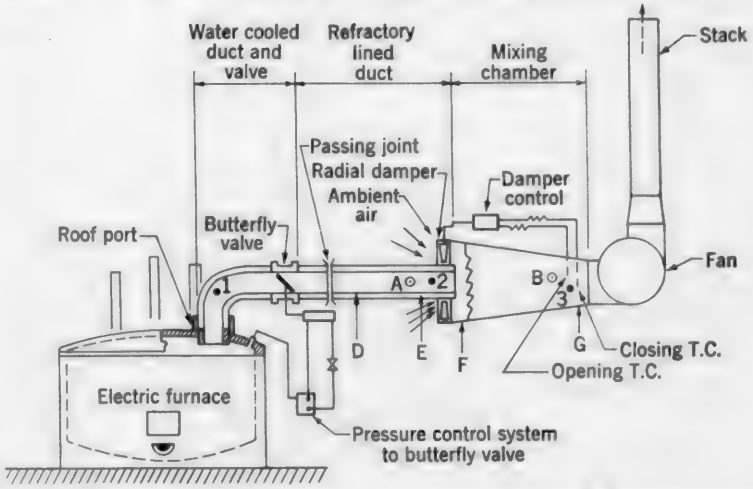


Fig. 11. Diagram of test set-up for evaluation of direct shell evacuation of small furnaces at Firth Sterling, Inc., McKeesport, Pa.

TABLE 7—COMPARISON OF ELECTRIC FURNACE VENTILATION METHODS

Item	General Ventilation				Local Exhaust Ventilation		
	Natural Draft Roof Ventilation	Mechanical Draft Roof Ventilation	Canopy above Craneway	Canopy below Craneway	Semi-enclosing Hood	Roof-Mounted Hood	Evacuated Shell Ventilation
Fume elimination	Erratic — poor	Erratic — Poor	Good	Good	Nearly complete	Complete	Complete
Air temp., normal maximum	Low	Low	Low	Low	150 F	250 F	2600 F
Cooling required	No	No	No	No	No	No	Yes
By-pass required	No	No	No	No	No	Some cases	Yes
Interference with Operator	No	No	No	Movable Hood	Movable Hood	Rarely	No
Interference with Metallurgy	No	No	No	No	No	No	Debatable
Furnace changes required	No	No	No	No	No	Occesionally	No
Electrode Consumption	No increase	No increase	No increase	No increase	No increase	No increase	Probable increase
Roof life	No decrease	No decrease	No decrease	No decrease	No decrease	Debatable	Probable decrease
Effect of weather	Critical	Important	Slight	Slight	None	None	None
Required air vol.	High	High	2nd high	3rd high	4th high	Moderate	Lowest*
Hood and duct deterioration	None	None	None	None	Minor	Possible	Possible
Order of system cost (with fume collection) 1 = low	1 (no collector)	2 (no collector)	7	6	4	3	5
Building drafts nullify	Yes	Yes	Yes	Yes	Partially	No	No
Winter heat loss	High	High	High	High	Moderate	Moderate	None

*With spray cooling

arc furnace; however, measurements made on existing installations employing roof-mounted hoods have permitted heat balance calculations which approximate the actual quantity of primary furnace gases which become mixed with the exhaust ventilation air. The relationship of the weight of *furnace gas* to that of the total weight of gases handled by the exhaust ventilating system is expressed in the following:

$$C_g(t_g - t_m)\,W_g = C_a(t_m - t_a)\,W_a + C_w(t_m - t_a)\,W_w$$

$$W_a + W_w = W_m - W_g$$

Since the value of $C_w(t_m - t_a)\,W_w$ (for air cooling) is small respecting the total, it may be safely ignored, and the relationship becomes

$$C_g(t_g - t_m)\,W_g = (W_m - W_g) \cdot C_a(t_m - t_a)$$

where

C_g, C_a, and C_w = Specific heats (constant pressure) of furnace gas, ambient air, and water vapor, respectively

t_g, t_m, and t_a = temperature, degrees F, of gas, the gas-air mixture, and the ambient air, respectively

W_g, W_m, W_a, and W_w = Weight, gas, mixture, air and water vapor, respectively.

The value of W_m may be obtained from volume measurements of existing furnace ventilation systems converted to weight basis. Judgment is required in making corrections to furnace gas volumes obtained from operating installations for application to non-ventilated furnaces.

Typical values of W_g per ton metal poured follow:

Type Melt	Tons/Hr	W_g, lb/Ton*	Est. t_g, F
High Carbon	2.6	2100	3000
High Carbon	8.2	2070	3000
Stainless	8.25	1265	3000

* Measurements made during oxygen lancing.

Theoretically, for a given furnace and type of melt, the value of W_g should be the same for any given method of fume control; however, it seems reasonable to allow a factor of safety in applying these calculations to direct shell evacuation. Once the value of W_g is approximated, the system capacity for shell evacuation may be calculated depending on the method of gas cooling selected.

Because of the problems incurred in studying the operation of an existing system and applying the results to another unventilated furnace, the above relationships are of theoretical interest in most cases. Nearly all the ventilation capacity data so far obtained are based on the use of roof-mounted furnace hoods. The following tabulation of recommended ventilation capacities for roof-mounted hoods is based on the stated melting rate and power consumption and will result in ventilation gas temperatures normally about 150 deg F with surges to not over 275 deg. These capacities must be increased by approximately 15% if oxygen lancing is practiced.

Furnace Roof Ring Diameter, Ft	Maximum Charge, Tons	Melt Rate, Tons/Hr*	KWH/Ton*	CFM @ 150 F
6	1	1.0	550	9,000
7	2	1.6	550	11,000
7.5	3	2.0	550	13,200
9	6	3.0	525	18,400
11	10	4.0	525	21,000
12	15	6.0	500	28,000
15	25	8.3	500	37,000
18	50	12.5	500	54,600

* Changes in these values will influence cfm.

The temperature of furnace gases just as they leave the shell is difficult to measure accurately, and present practice assumes that it approximately equals the melt temperature. Fig. 12 illustrates the temperature surge during the "boil" in an 8400 lb charge furnace equipped with a roof-mounted hood handling 2500 cfm per ton charged.

The use of previously published data relating recommended exhaust system capacities to furnace size and capacity has led to a few instances where furnace ventilation was inadequate and gas temperatures excessive. These occurrences tend to confirm the fact that the requirements of each furnace and/or melt shop differ, justifying careful study of all variables in sizing fume control equipment.

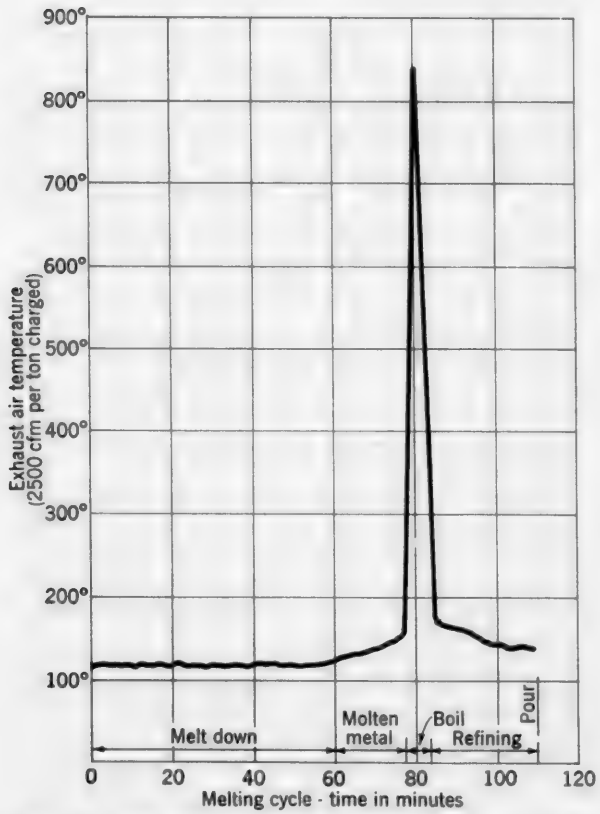


Fig. 12. Ventilation gas temperature vs. phase of the heat in an 8500 lb charge furnace ventilated at the rate of 2500 cmf per ton charged. After Kane, J. M., Trans. A.F.S. 48th Annual Meeting, 1944.

Gas Cleaning Equipment

If it is desired to discharge to atmosphere a gaseous effluent free from visible solids, it is necessary to clean the furnace ventilation air and the gases to a final concentration of solid contaminants in the range of 0.025 to 0.03 grains per standard cubic foot. This degree of gas cleaning can be accomplished only by the most efficient equipment. Ruled out because of inherently low collection efficiencies against fine particulate matter are such devices as settling chambers, dry centrifugal or inertial type collectors, spray chambers, etc. The following types of gas cleaning equipment have been applied in electric furnace fume control installations with varying degrees of success:

(1) Wet scrubbers.
  (a) Orifice-type.
  (b) High energy-type.
  (c) Rotary disintegrators.

(2) Cloth Filters.
  (a) Tubular type, mechanically shaken.
  (b) Tubular type, reverse air cleaning.

(3) Electrostatic Precipitators.

Wet Scrubbers: Many installations of orifice-type scrubbers in conjunction with roof-mounted furnace hoods have been made to abate local nuisance problems. The orifice-type scrubber is capable of removing 65 to 75% by weight of electric furnace fume. Collection efficiencies of this magnitude may satisfy some air pollution codes; however, the effluent gases contain visible solids to the extent that opacity requirements are generally exceeded.

Scrubbers in which the water is retained or recirculated must be constructed of corrosion-resistant materials or protected by the regulated addition of neutralizing reagents to counteract dissolved acids.

High energy scrubbers operate in the range of 12 to 30 inches w.g. pressure drop, the collection efficiency generally being in proportion to the pressure at which the devices operate.

In an eastern steel plant, a Venturi scrubber has been installed cleaning 65,000 cfm of gases and ventilation air from a 20-ft diameter furnace. The pressure drop through the scrubber is 24 inches w.g., requiring a 600-hp exhauster motor. Its weight efficiency is adequate under the provisions of most existing air pollution codes.

Rotary disintegrators are properly classified as high energy scrubbers. In a mid-west integrated steel plant, three 75-ton and two 200-ton electric furnaces are exhausted by shell evacuation through individual spray chambers into a common duct system. Partially cooled gases pass through a primary cleaner and cooler into steam turbine driven 45,000 scfm rotary disintegrators operated in parallel. Entrained moisture leaving the disintegrators is removed in rubber lined centrifugal water eliminators. The system capacity is 50,400 scfm, and each disintegrator is rated at 650 hp. Collection efficiency reported by H. W. Peterson in AIME Electric Furnace Steel Proceedings, 1956, is 99% by weight.

Large installations of high energy gas scrubbing equipment generally include rather extensive treat-

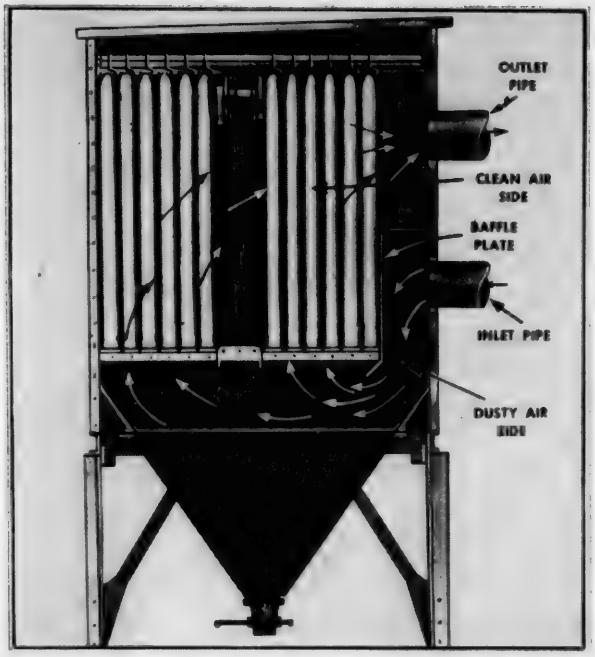


Fig. 13. Artist's cross-section of mechanically-shaken, tubular cloth dust collector widely used for electric furnace fume control. Wheelabrator Corp.

ment facilities to clarify the effluent water, thus permitting recirculation.

Cloth Filters: Based on successful pilot testing in Los Angeles County in 1952, more than 50 electric steel furnace fume control installations have been made employing mechanically shaken, tubular cloth filter type dust collectors in conjunction with roof-mounted or canopy hoods. In addition, there are three

Fig. 14. Pressure-type, weather-protected baghouse employing treated Fiberglas bags and reverse air cleaning at west coast steel mill. This unit filters 80,000 cfm of spray-cooled gases from the direct evacuation of two 100-ton furnaces. R. S. Coulter.

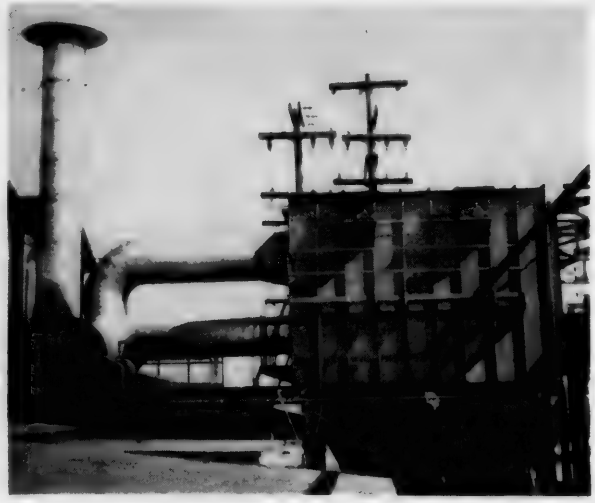


Fig. 15. Mechanically shaken tubular cloth dust collector cleaning gases from furnace in Fig. 1. Capacity, 32,500 cfm. Note clean stack. Wheelabrator Corp.

baghouse installations utilizing shell evacuation for furnace ventilation. Of these, two include mechanically shaken, tubular filters and the use of tempering air for cooling the furnace gases. The other spray-cools the gases down to about 450 deg F, following which the gas and water vapor mixture is filtered in a tubular baghouse utilizing silicone treated Fiberglas filter bags cleaned by reverse air.

Because of the fineness of electric furnace fume, it can be effectively removed from the filter cloth surfaces only if the cloth is flexed. Flexing may be accomplished by mechanical shaking of the filter bags or by collapsing them with reverse air (i.e., air flowing through the filter fabric in a direction opposite to the normal). Bumping or jarring cloth envelopes supported on wire frames or screens has not been effective as a method for removing accumulated dust and fume from the cloth surfaces. The filter bags in all of the above installations are fabricated from woven cloth and, in most cases, synthetic fabrics, such as Orlon and Dacron, have been employed because of (a) the gas temperatures handled and (b) the corrosive constituents in the furnace gases which may be expected to gradually degrade natural fibers.

Figure 13 is a typical cross section of a tubular cloth filter dust collector equipped with a mechanical bag shaking device, representing the most frequently employed design encountered in electric steel furnace fume control installations. Figure 14 shows a large baghouse employing reverse air cleaned Fiberglas filter bags. This unit cleans water cooled gases from the shell evacuation of two 100-ton furnaces melting "open hearth" grade steel. Figure 15 illustrates a mechanically shaken cloth filter employing Orlon bags cleaning gases from the furnace illustrated in Figure 1-b. Perhaps a half dozen installations for electric steel furnace gas cleaning have been made employing reverse jet filters and felt filter bags. At the high air-to-cloth ratios at which reverse jet filters are ordinarily operated, there have been some difficulties in removing the

Fig. 16. Mechanically shaken tubular bag cloth filter serving two electric steel melting furnaces. All but six of the original Dacron bags in the four-year-old installation at National Supply Co., Torrance, California, are still in service. Dracco Div., Fuller Co.

fine furnace fume particles imbedded in the felt filter media by the action of the traveling air jet.

Figure 16 shows a mechanically shaken tubular bag Dacron cloth filter cleaning ventilation air from two electric steel melting furnaces which are equipped with roof-mounted hoods with swivel type duct connections. All but six of the original Dacron bags are still in service after four years of use at the National Supply Co. plant in Torrance, California.

One advantage, exclusive to cloth filters, is their uniformly high filtration efficiency against extremely fine fume particles regardless of variations in gas conditions, dust loading, etc. A properly designed cloth filter will remove well over 99% of the fume by weight, giving an effluent free from visible solids.

Among the existing cloth filter systems, capacities range from 10,000 to 100,000 cfm at resistances in the range of 9 inches S.P. and at filtration temperatures ranging up to 275 deg F (Orlon, Dacron) and 450 deg (Fiberglas). Typical power consumption figures for cloth filter installations range from 2 to 2½ connected horsepower per 1000 cfm.

Electrostatic Precipitators: Because of their cost, the use of electrostatic precipitators for steel furnace fume control has been limited to larger furnaces. There are at present two relatively large precipitators cleaning gases via shell evacuation and water spray cooling. In both instances, dry plate-type precipitators are employed in conjunction with water spray gas conditioning. Satisfactory collection efficiency depends on the ability to operate at the temperature associated with the lowest resistivity of the deposited dust and fume. Thus, the two operating units have been found to operate best at gas temperatures of 127 and 250 deg F respectively. At the lower temperature, considerable condensation and resulting corrosion have been experienced. Based on experience to date with existing electrostatic precipitators, collection efficiencies against electric steel furnace fume will run from 90 to 95% by weight.

TABLE 8—COMPARISON OF GAS CLEANING EQUIPMENT FOR ELECTRIC STEEL FURNACE FUME CONTROL

Item	Wet-Collection			Dry Collection	
	Orifice Scrubber	Venturi Scrubber	Rotary Disintegrator	Cloth Filter	Electrostatic Precipitator
Collection efficiency by weight	65–75%	95–98%	95–99%	99+%	90–95%
Variations in efficiency	Yes	Yes	Yes	No	Yes
Visible discharge	Yes	Variable	Variable	No	Variable
Relative Cost	Low	Medium	High	Medium	High
Operating temperature, F*	350	600	350	275–550	600
Space required	Low	Low	Low	High	Low
Power Cost	Moderate	High	High	Moderate	Low
Gas conditioning or precleaner reqd.	Varies	Varies	Varies	No	Yes

*Temperature limit for office scrubber and rotary disintegrator based on undesirable steam generation at high temperatures which would require pre-cooling. Cloth filter limits depend on fabric used. Precipitator temperature depends on need for gas conditioning.

A comparison of the various gas cleaning devices currently employed for steel furnace fume control is made in Table 8.

Summary

Of existing electric steel melting furnace fume control systems installed to meet provisions of air pollution regulations, by far the majority employs roof-mounted furnace hoods in conjunction with mechanically shaken, tubular cloth filters. There is, however, a noticeable trend toward furnace shell evacuation, particularly for larger furnaces, coupled with water spray gas cooling and cloth filtration. Silicone-treated Fiberglas filter bags cleaned by reverse air flow appear feasible.

The high cost and variable performance of electrostatic precipitators in this application may be expected to confine their use to the control of fume from very large multiple furnace installations where specific conditions may rule out the use of cloth filtration. High energy scrubbers can be depended upon to do a satisfactory gas cleaning job, although at the expense of high power and water consumption. Their use will depend in some measure upon local conditions such as water supply and disposal facilities and air pollution code restrictions.

The choice of gas cleaning equipment notwithstanding, the evaluation of the many electric steel furnace fume control systems installed in the past 8 years, has removed the uncertainties from the design and sizing of fume control equipment for electric furnace shops.

Louis Blendermann on PLUMBING and PIPING

Lawn Sprinkler Systems

NEW BUILDINGS are being erected on spacious grounds in many suburbs. These buildings are carefully designed to harmonize with the surroundings of the area and the grounds are attractively landscaped to produce a building plot which is an asset to the community. The light industrial type building is typical, where landscaping and site hide most of the plant operations and help to retain the peaceful atmosphere of the area.

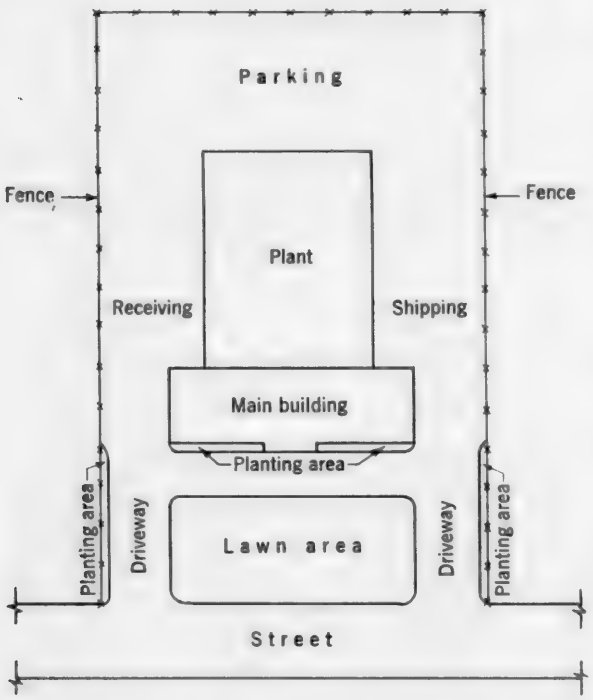


Fig. 1. Relation of lawn area to industrial plant site.

Large landscaped areas require considerable attention, particularly the lawn. Unless the lawns are adequately watered by the groundkeepers, they will soon lose their attractive appearance. The installation of a lawn sprinkler system is therefore considered important. This system can be operated either manually or automatically. This article discusses the design of a lawn sprinkler system that might be utilized for a typical industrial building site although the information can be applied to any type of building. Structures such as hospitals, research laboratories, doctors' clinics, garden type apartment houses and numerous other types of buildings are being erected in the suburbs. A lawn sprinkler system can be used to excellent advantage with each of these buildings both from a practical as well as a decorative viewpoint. Moreover, a decorative water spray or fountain can really enhance the front of any building.

Application of a Lawn Sprinkler System

A typical industrial plant site which is used as an example in this article, is shown in Fig. 1. It is situated on a large plot. Adequate space has been provided for shipping and receiving as well as for employee parking. The portion of the site facing the street is well landscaped and includes a spacious lawn area. When properly maintained, this area will enhance the property and present a neat, attractive appearance to the passing traffic. A single lawn area of medium size has been used for illustration.

Spacing of Lawn Sprinklers

To achieve an even distribution of water, the lawn sprinklers must be so placed that they will completely cover the entire lawn area as shown in Fig. 2.

The spray pattern is arranged that each sprinkler spray will overlap the other. This consideration will provide overall coverage despite slight water pressure variations that may occur from time to time. The small voids near the curb do not matter since water accumulation at the edge of the lawn will take care of the voids.

The maximum coverage offered by each sprinkler

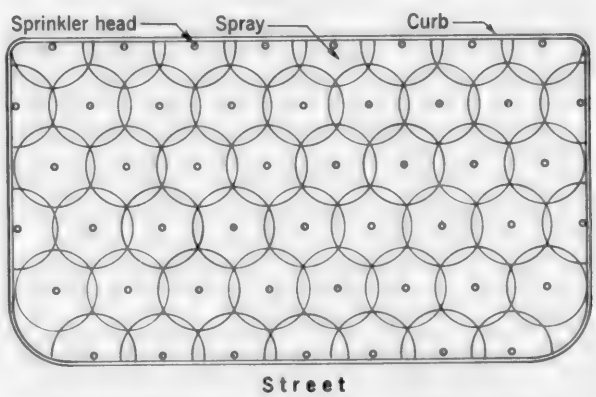


Fig. 2. Typical spray pattern of sprinklers for a lawn area.

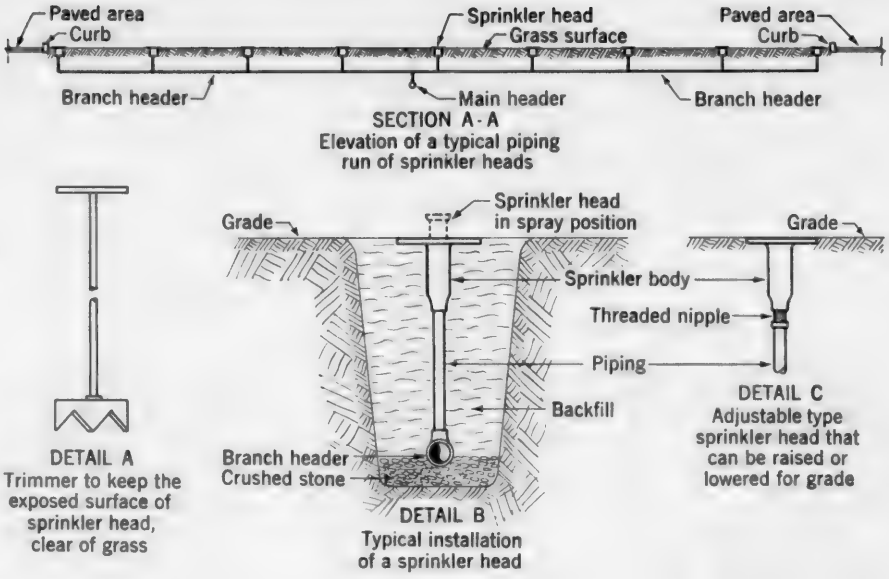


Fig. 4. Details pertaining to the installation of lawn sprinkler heads.

head is dependent upon the specific design of the head and the water pressure utilized. Precise information of this nature can be obtained from the manufacturer of the equipment favored by the engineer. The manufacturer's reference material will denote the minimum and maximum effective spray pattern of each of the heads with the effect of varying water pressures.

The regular spray head covers an area of 360 deg and the heads at the curb an area of 180 deg. Other desired spray patterns for specific needs can be worked out with the manufacturer. It is extremely important with the placement of the lawn sprinklers that the spray does not exceed the limits of the lawn area. When this situation occurs, it gives the impression that the system was not properly designed. The overall spray pattern will lose much of its decorative beauty and it may create a nuisance.

While a lawn sprinkler system assures a healthy lawn, it also provides one of the most distinctive means to enhance a building site. It is economical in supplying the prescribed amount of water, for regular hand means for watering lawns can often be most wasteful.

Arrangement of Lawn Sprinkler Piping

The lawn sprinkler piping must be arranged to satisfy the desired spray pattern. A typical piping arrangement is shown in Fig. 3.

This is a rather simple arrangement but it illustrates a method utilizing all the sprinklers at one time. The piping consists of a water supply from the building, a main header and branch headers. The main header is an equalizing line serving the branch header. The water supply is connected to the main header at the mid-point between the several rows of branch headers. In this manner, a uniform pressure is provided to all the sprinkler heads and the spray pattern will be uniform in intensity. A lawn sprinkler system loses some of its decorative effect when the overall spray pattern varies in volume.

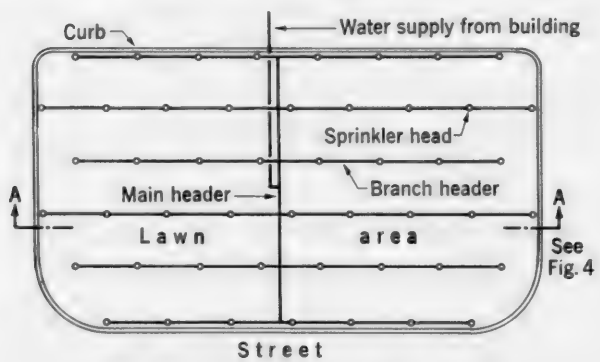


Fig. 3. Arrangement of sprinkler piping.

Many piping arrangements can be used although several factors help determine the best piping arrangement. The first thought is to provide a complete system with the least amount of piping. This can be accomplished by plotting several arrangements on paper and then scaling the total lineal feet of piping involved for each method.

The required trenching is a factor for excavation of trenches can be rather costly. It is suggested that this factor be considered when the systems are plotted on paper. A piping arrangement should be found that requires the least amount of excavation and the details must be decided by the engineer.

Assuming that the water pressure from the building supply is adequate, care must be exercised in calling for the proper slope of piping so that the water remaining in the piping can be drained off in the building, in areas where the water is subject to freezing during the winter months. All the piping must be properly sized and the entire system balanced, if the system is to fulfill its intended function. It is suggested that the manufacturer of the lawn sprinkler system be called upon recommendations.

Installation of Sprinkler Heads

Details concerning the installation of sprinkler heads are shown in Fig. 4.

Section A-A represents a typical arrangement of branch headers on either side of the main header. The branch headers are normally installed within a range of 12 to 24 inches below the surface of the lawn. The engineer may specify any depth he favors,

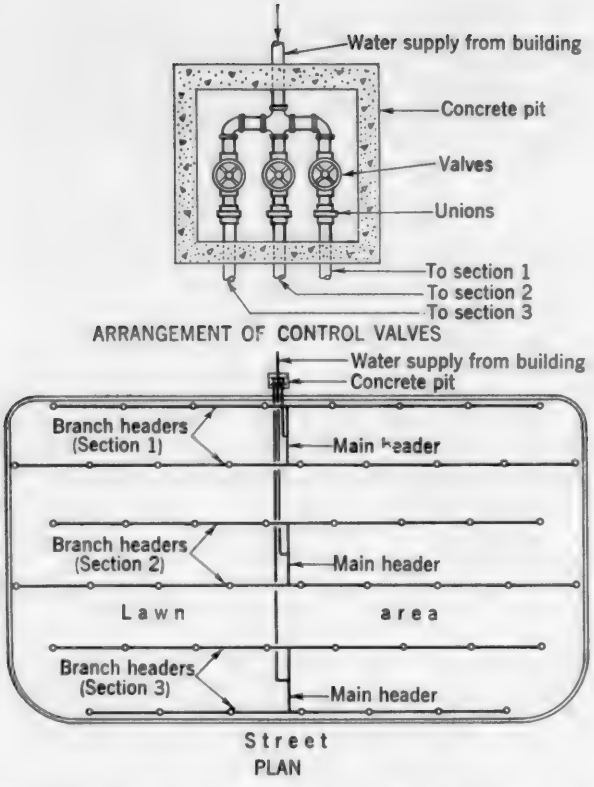


Fig. 5. How arrangement of sprinkler piping can be subdivided when there is insufficient water or pressure for an entire system.

dependent upon the overall scope of the system contemplated. The piping is sloped to permit the water remaining in the piping after use at the end of the season, to drain back into the building where it can be drawn off.

Several piping materials may be considered for the lawn sprinkler system; the material selected is based on the engineers' judgment and the particular characteristics of the water and soil. Copper tubing is, perhaps, the most generally used material for this purpose although plastic piping is being used in increasing amounts. Material selection must be carefully considered and piping manufacturers should be consulted for their recommendations.

Many types of sprinkler heads are available, ranging from inexpensive heads to deluxe models. Each has a definite advantage and the engineer must make his selection accordingly. The pop-up type spray head is most popular. Water pressure lifts the head to spray position, as shown in Detail *B* of Fig. 4.

Crushed stone covers the trench bottom as illustrated in Detail *B*. This means is followed where a positive slope of piping is to be maintained. Other methods favored by the engineer can be used with equal success.

Detail *A* shows a trimmer device for removing the grass around the sprinkler head. If the grass growth is not controlled, it can move the sprinkler head out of alignment, and it can interfere with the action of the pop-up head.

Since the grading will settle due to (1) from foot traffic, (2) the weight of grass cutting machines and (3) because the branch header is subject to some settlement or movement, it is advisable to consider a means of installation that will provide some extent of flexibility. Detail *C* shows an adjustable type head that can be raised or lowered to satisfy the changing conditions of the grade. Adjustment can be made by turning the head to assure that it will always be flush with the grade elevation.

Sectionalization of Lawn Sprinklers

Very often, due to the size or scope of the lawn area to be sprinklered, or the lack of sufficient water volume or pressure, it will become necessary to water the lawn in sections. There are several ways in which it can be accomplished. Figure 5 shows a method that may be utilized with the particular lawn area shown.

In this case the lawn area has been divided into 3 sections. The control valve for each section has been placed in a concrete pit outside of the lawn area. The operator will water one section of the lawn for a prescribed period of time and then shut it off to water another section. Since the valves are located outside of the lawn area, the operator can work the valves without getting wet. The detail shows how the valves can be placed in the pit for ease of handling. The engineer may use some other method he favors.

Another method that permits the sectionalization of a lawn sprinkler system is shown in Fig. 6. This method places the control valve near each section it serves, as may be required in some installa-

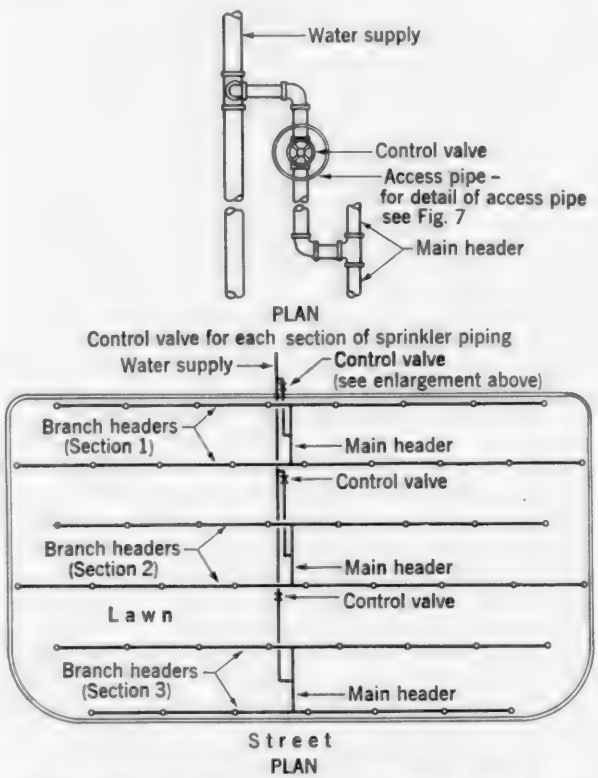


Fig. 6. Another arrangement of sub-division when there is insufficient water or pressure for an entire system.

tions. Access to the underground valve is gained by means of a length of clay pipe that is placed in the ground, flush with the grade. The operator removes the cover to turn on the valve. In each case, the valve is installed out of the range of the water spray for the section it controls. Here again, other arrangements may be used; the one shown is for example only.

Access to Control Valves

Since the control valves are placed on the underground piping, proper access must be provided. Several methods are detailed in Fig. 7.

Detail *A* (Fig. 7) shows how an extension can be used to provide a means of control at grade level. The extension is affixed to the valve stem and is extended through a small slab of concrete and above the grade. This control valve must be placed out of the spray range of the particular section of lawn sprinklers it serves. This method provides an ease of access for the operator.

Detail *B* shows how a piece of clay pipe can be used. It is only necessary to remove the cover to gain access to the control valve. Here again, the control valve must be remotely located away from the spray pattern of the section of the lawn sprinklers it serves. The clay pipe can be cut to any desired length.

Detail *C* consists of a manufactured cast iron access pipe with a hinged cover for ease in gaining access to the control valve. The cast iron pipe can be cut to any desired length. Other devices are available and the engineer can select the method most suitable. It is important that the contractor carefully handle these details.

Drainage of Lawn Sprinkler Systems

In cold climates, it is most urgent that the water be drained from the underground piping system at the end of the season. Otherwise, the underground system of piping, which is buried with shallow fill, can freeze and rupture the piping or sections of piping can be moved out of alignment.

Figure 8 shows two methods that may be used for drainage. Whenever possible, it is desirable to slope the underground piping so that the water in the piping will drain back into the building where it can be drawn off with relative ease. However, when large lawn areas are involved, this means cannot always be used. Consideration must be given to other methods, using other locations.

These methods are illustrated on Fig. 8. The plan of this figure shows a typical site and indicates just

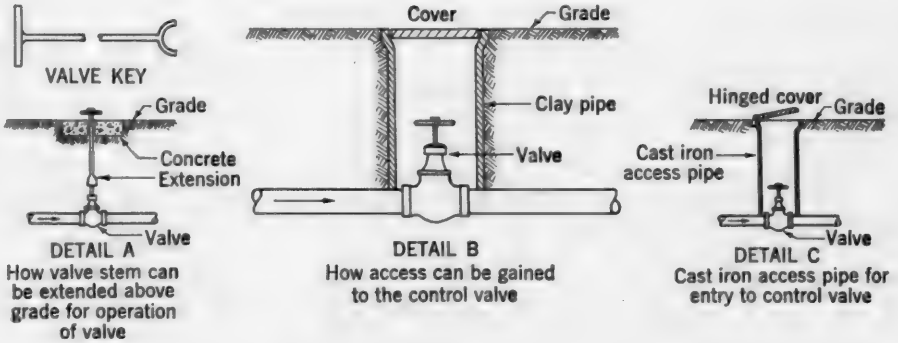


Fig. 7. Methods which may be used to operate underground control valves.

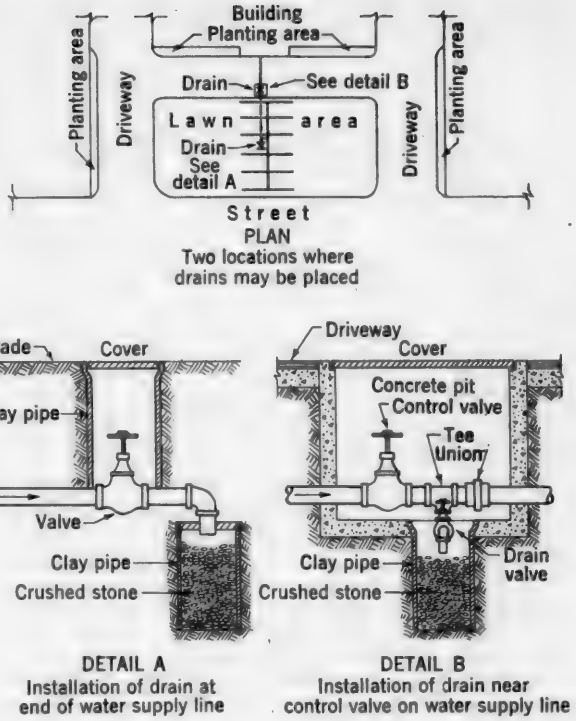


Fig. 8. Methods that may be used to drain lawn sprinkler piping.

where the points of drainage might be applied. They are denoted by the two valves, as shown.

Detail *A* (Fig. 8) shows how a drain may be installed at the end of the water supply line. The piping in this case must be sloped in the direction of the drain. A valve is installed at the end of the piping, and when this valve is opened, water in the piping will drain into the length of clay pipe which has been filled with crushed stone. A piece of clay pipe has been used at grade to offer access to the valve. The size of the drainage pipe is determined on the basis of the amount of water that will be contained in the underground piping system.

Detail *B* represents a drainage means which is placed near the valve that controls the supply of water to the lawn sprinkler system. The means consists of a drain valve which when opened, permits the water to drain into a piece of clay pipe, again filled with crushed stone. The entire assembly is housed in the concrete pit as shown.

Liquid Carryover Can Be Avoided

Situations where liquid carryover occurs — Chiller saved by knockout drums — Pumpdown is no panacea — Slug-producing traps

BROKEN VALVES, bad cylinder wall lubrication, and worse can result when liquid refrigerant is allowed to leave an evaporator with refrigerant gas.

What are the chief reasons causing liquid to leave the evaporator? One of the most important is the sudden expansion that occurs when an added load is thrown on an evaporator coil.

Suppose a kettle of water with a little oil in it is boiling gently over a stove, and as it boils away more water is constantly added to keep the level just below the spout. If, then, the gas is turned up quickly, the level of the boiling water will rise and steam and boiling water would pour out of the spout. This despite the fact that, at the instant the flame was turned up, no more water was added.

In a refrigeration system, should a compressor switch from 75% to 100% capacity (a 33% increase in the rate of heat removal) or from 25% to 50% (a 100% rise) there will be a tendency to boil over. In a flooded evaporator, the foaming level will rise and, if the evaporator has not enough surge volume, liquid will spill over into the suction line.

During steady operation of a direct expansion evaporator with feed controlled by superheat, the liquid will be far enough removed from the end of any circuit to permit the number of degrees of superheat for which the expansion valve has been set. Should an added load be thrown on the evaporator (should air, chilled water, or brine temperature quickly rise) the rate of boiling will increase, bringing the liquid nearer the end of the circuits, possibly into the suction line.

The situation may be more critical when compressor capacity increases. Other factors remaining the same, an increase in compressor capacity reduces both pressure in the evaporator and the temperature of the boiling liquid. The effect of a drop in pressure is to open the expansion valve. The decrease in temperature at the expansion valve bulb, which is the combined result of lowered liquid temperature and the fact that some of the liquid will approach or pass the end of the evaporator, tends to close the expansion valve. Because the effect of pressure drop will be transmitted to the valve diaphragm almost instantly, while the effect of temperature drop is much slower, the expansion valve will open wider for at least a few seconds, until an equilibrium is again established.

This lag in the temperature sensing function of the expansion valve bulb should be as short as possible, emphasizing the importance of a good quality bulb and its proper application with good copper or aluminum straps. It can be seen why there should not be any insulation in close contact with the bulb, since the heat storage in the insulation will retard changes in temperature of the bulb itself.

In systems with more than one evaporator, liquid carryover is often a problem. As an example, assume a refrigerant circuit with two air conditioners, each with its own evaporator and a solenoid valve in the liquid line to each. One conditioner, with liquid solenoid open, is in regular operation; the other is not in use, so its valve is closed. The closed valve has normal suction pressure under its diaphragm. Its bulb is at room temperature, probably about 75 deg F. Therefore, the valve is wide open, ready to pass refrigerant to the limit of its capacity.

The idle air conditioner is now started up. Because room temperature is above the thermostat setting, the solenoid valve opens. Refrigerant liquid now enters the evaporator at the highest rate. The expansion valve will not begin to limit the feed rate until the cooling effect reaches the point where the bulb is located and then removes sufficient heat to cool the fluid inside the bulb and condense enough to lower the pressure to that corresponding to about 15 deg above the suction pressure (assuming a 15 deg superheat setting). This takes place in one to five minutes, during which rather large quantities of liquid may have reached the suction line.

If the load on the evaporator at this time is the same as the maximum capacity of the expansion valve, there is no problem, because all the liquid will evaporate. However, the load may be much less than the expansion valve capacity, for several reasons: (1) Valve capacity may be larger than the maximum coil load because the smallest standard valve which is large enough is somewhat too large. (2) The air conditioner may have a face and by-pass damper and the room is only a little above the desired temperature. Thus, the dampers may be adjusted to pass only a small portion of the air over the evaporator, providing only a small part of the maximum evaporator load. (3) The air conditioner may be of the multizone type and air for only one small zone may be passing over the evaporator. (4) The proportion of outside air may be appreciable. If its wet bulb temperature is considerably below the design condition, there results a low evaporator load. Combinations of *1*, *2* and *4*, or *1*, *3* and *4* will make the condition worse.

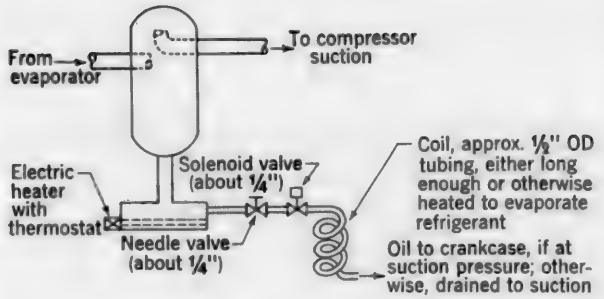

From evaporator
To compressor suction
Electric heater with thermostat
Solenoid valve (about ¼")
Coil, approx. ½" OD tubing, either long enough or otherwise heated to evaporate refrigerant
Needle valve (about ¼")
Oil to crankcase, if at suction pressure; otherwise, drained to suction

Fig. 1. (above) Knockout drums with tangential entrances prove very effective, are good insurance.

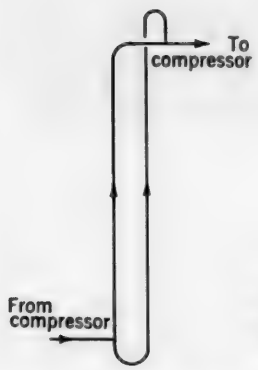


Fig. 2. (left) Operation of double suction line depends on liquid seal which may return to the compressor as a slug.

A refrigerating system, having automatic control of capacity, is likely to have been operating at its lower or minimum capacity just before it shut off. The amount of refrigerant in the evaporator is near the maximum, as required for a low rate of boiling. Pressure in the evaporator builds up (by evaporation of a very small amount of the liquid in the evaporator) to that corresponding to the evaporator temperature. The expansion valve bulb temperature rises to that of the ambient.

On restarting the next morning, the conditioned area (or the fluid being cooled) is at a temperature calling for full capacity. With this higher heat removal rate, the more active boiling may result in liquid reaching the suction line.

Brine Chiller Saved by Knockout Drums

This happened on each circuit of a two-circuit brine chiller with separate compressor and condenser separately connected to each circuit. Each compressor had a means of unloading to permit operation at 50% or 100% of capacity. Other chillers and compressors also cooled this brine when the demand was high. These particular two compressors would automatically drop to 50% capacity and then stop, as the load fell. Restarting was manual.

When a compressor started, the time delay relay for reduction of starting torque kept the compressor at 50% capacity for about 45 seconds, then allowed 100% capacity. During the 45 second period, the suction was free of liquid. At the instant of return to 100% capacity, liquid in damaging quantities returned with the suction. The same result was experienced with each compressor. The more rapid heat transfer made these evaporators boil over and into the suction line.

A knockout drum of adequate size, was installed in each suction line. The knockout drum, similar to that in Fig. 1, catches the liquid. A heater evaporates the liquid which is caught in it and the gas goes to the suction. The oil drains to the crankcase. The knockout drum is empty before it is required to catch the next slopover.

This discussion has emphasized the difficulty of eliminating any chance of liquid carryover. Good controls, which maintain nearly steady suction pressure at all loads and capacity changes, help reduce the problem to a minimum. But even if the controls are such as to eliminate it, a failure of one of the controls may cause it. An accidental feed of too warm fluid to a chiller may cause refrigerant to boil at an excessive rate. The cost is high when this results in serious damage to a compressor.

There are those who balk at the extra cost of a knockout drum. In contrast, the service manager of a large contractor told me that they install a knockout drum on any but the simplest jobs. His estimate was that it had reduced their service calls by 90%.

Pumpdown is No Panacea

A pumpdown control is sometimes used in an attempt to eliminate the large quantity of liquid in the evaporator at start-up. With this arrangement, the solenoid liquid valve is closed and the compressor operates as necessary to keep the evaporator pressure low enough to allow all the liquid in it to evaporate.

It should be remembered, though, that the expansion valve, if of the superheat control type, will be wide open. When the system is first started, and the liquid solenoid opened, the liquid will enter at full valve capacity for a minute or more, before the bulb is cool enough to control. If the load matches the valve capacity at the time, there will be no slopover. If the load is considerably less, the liquid will not evaporate fast enough to equal the rate at which it enters and some liquid may leave the evaporator.

Pumpdown will often eliminate liquid carryover at the start but it should not be considered an infallable solution. It is also limited by the fact that the lowered evaporator pressure may not be permissible in some cases, because of freezing danger.

When there is only a single evaporator with one expansion valve in a refrigerant circuit, the possibility of too much liquid in the evaporator may be eliminated by limiting the total charge to that required for a full liquid line only when operation is at full capacity. If, at part capacity, the expansion valve opens to let more liquid into the evaporator, there will be no more to let in. The liquid line will show some gas at part capacity.

Traps Are Slug Producers

Any traps in the suction line, where liquid can accumulate at low loads or condense (because surrounding temperatures are below that corresponding to the pressure in the suction line) may result in liquid carrying to the compressor.

Double suction risers, as shown in Fig 2, operate by trapping liquid (usually oil) which is likely to return as a slug when the compressor capacity suddenly increases. Double suction risers are very seldom required. It should be understood that they are slug producers.

"Lesson for Today: Cooling with Steam"

H. B. SWYGERT
Lyles, Bissett, Carlisle & Wolff, Architect-Engineers
Columbia, South Carolina

THE AIR CONDITIONED UNDERGRADUATE LIBRARY OF THE University of South Carolina is a pre-eminent example of contemporary design, and is in complete contrast to the library located on the campus and constructed in 1840.

The main floor of the new library is 150 ft long and 75 ft wide, the mezzanine is 150 ft by 52 ft providing a total usable area of approximately 40,000 sq ft. A library is essentially made up of books, a system of distribution and comfortable, well-lighted reading rooms. The undergraduate library was designed to house 60,000 volumes in its stock and is primarily used for students working towards the bachelor's degree.

Protection and preservation of the over 60,000 volumes, consisting of reference books, manuscripts, and priceless records of civilization, is of prime importance and trust, with the comfort of the occupants being of secondary consideration. Research has disclosed that abrasive dust, acidic pollution of the air, and light, along with the ambient conditions, must be considered in the design of the mechanical system so as to minimize the deteriorative agents. Controlled conditions by mechanical means thereby becomes justified on the basis of both economics and sentiment. The normal recommended inside conditions are 80 deg F d-b and 40 to 50% relative humidity in the summer and 70 deg d-b and 40-50% relative humidity in the winter.

Central System

The general layout of the library with its vast reading rooms, open stack areas and public spaces dictated that a central system would best fulfill the requirements of the library. Some of the other features influencing the selection of the central system were:

(1) Independent zones with reheat coils can be utilized to prevent excessive relative humidities resulting from fluctuation in the room loads with corresponding changes in the sensible heat—latent heat ratio; (2) The vast glass areas were oriented north and south, minimizing both cooling load and zoning requirements; (3) A spray system can be included as an integral part of the central system to eliminate sulfur dioxide from the air; (4) Suitability for un-interruptable service or dependability; (5) Air filtration by the use of moving curtain renewable media type automatic filters; and (6) the adaptability of the components into a central unit for supplying air through a conventional low velocity, low noise level duct system. The advantages of a central system are: (1) Involves a lower initial cost; (2) Provides much greater accessibility, if doors are provided in the casing, for cleaning, inspection and maintenance of all the component parts; (3) Closer control of desired conditions leaving the coils; and (4) Permits remote location of the air handling units to minimize possible noise complaints.

Two handling units of the built-up type were installed to fulfill the comfort requirements and to suit the building design. The unit serving the main floor and mezzanine was located on the roof, and the second unit serving the basement and stack areas was located in the main equipment room in the sub-basement (See Fig. 1). Air is supplied from each unit to the various zones through ductwork and then to the occupied areas through square ceiling diffusers for the interior areas. Due to the large glass areas and the possibility of downdrafts with overhead supply during the winter cycle, supplementary heating was provided around the sill of the glass by employing steam-supplied finned radiation with enclosures selected to blend architecturally with the store front material.

Steam Absorption Refrigeration Machine

In most air conditioning installations, the selection of the refrigerating plant must be based on an economic analysis. However, in this particular case economics was not the sole basis for the selection of an absorption refrigeration machine. In addition, two of the influencing factors were: (1) The availability of economical steam from a central steam system during the cooling season made a steam operated unit a natural; and (2) the installation of an absorption machine on the campus would, it was hoped, prove of invaluable aid in assisting the mechanical engineering department depict the application of steam to refrigeration.

The absorption machine is smaller in size and weight than any other type of refrigeration equipment and thereby affords greater flexibility in location. The

only moving parts of the absorption machine are the solution, evaporator and purge pumps, thereby reducing normal noise problems and limiting possible maintenance problems. The standard controls are mounted on a panel on the front of the unit and operate a capacity control valve in response to load demand with the ability to provide capacity from 100% full load down to zero capacity. This capacity range is important on buildings which may run 24 hours a day, such as the undergraduate library, since the efficiency on light loads remains relatively high. The smooth load characteristic of the absorption machine requires a minimum of attention without necessity for an operator to change controls to maintain constant chilled water temperatures. This factor certainly appeals to universities where operating personnel is at a premium.

Air Cleaning

A library, in particular, must be provided with an efficient air filtering system for preservation of the priceless literary contents. Excessive particles of abrasive and harmful dust and sulfur dioxide all have a detrimental effect on paper and bindings, on the furnishings and on the occupants. Therefore, the elimination or control of these factors must enter into the design of the mechanical system.

A completely automatic moving curtain type filter with a replaceable glass media was selected as the primary filtering system for each of the built-up air handling systems. This selection would free the air of as much contamination as practicable in accordance with the requirements of the application, and yet not require excessive initial fixed cost. The media for the filter is supplied in roll form, one roll normally sufficient for a minimum of one year's operation. The supply roll located at the top is operated and rewound at the bottom by a special switch actuated by pressure drop. The resistance of the filter will remain almost constant with a value of 0.5 inches water gage based on 500 fpm face velocity recommended for filter drop in selection of main supply fan. The dust removal efficiency is usually in the range of 80 to 85%, depending upon operating resistance and face velocity.

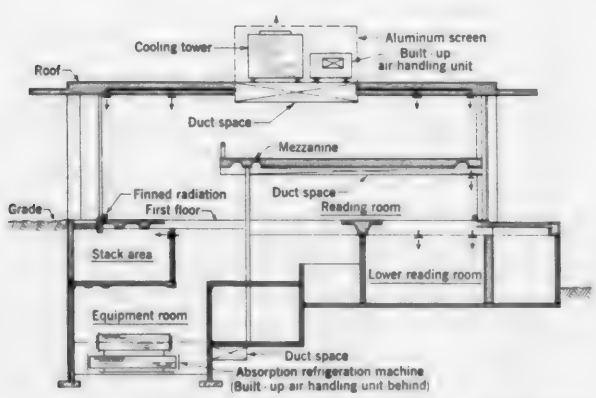


Fig. 1. Transverse section of undergraduate library shows cooling and heating components.

Fig. 2. View of reading room shows continuous finned radiation below glass, continuous strip air grille above glass, and square ceiling diffusers between lights.

The secondary filtering system was an air washer which forms an integral part of the built-up unit for removing both air-borne impurities and eliminating sulfur dioxide, provided the water is properly chemically treated.

Automatic Control

A completely automatic temperature control system was designed for maintaining the desired dry bulb temperature and relative humidity during both the cooling and heating cycles. The sequence of control for each air handling unit was arranged so that the normally closed outside air damper would open to minimum position on fan start-up, with a dewpoint thermostat positioning the preheat steam valve closed and modulating the chilled water valve fully open on a rise in dewpoint temperature. The reverse sequence occurs on drop in dewpoint temperature. The spray pump for the washer is controlled by a return air instrument that stops the pump on a rise in relative humidity. Re-heat coils located in ducts to the various areas are controlled by individual room thermostats located in the areas affected.

Completion

The undergraduate library was completed and pressed into operation by the University in the summer of 1959 and has been in use just under two years. The building being both spacious and functional has filled an important need for both the students and the University. The mechanical system consisting of steam for heating from a central steam system and a 100 ton steam absorption air conditioning system was installed at a cost of $940.00 per ton, representing a nominal cost for a quality system. The mechanical system has thus far met the requirements of the building for which it was designed and filled the demands of the University for which it serves.

Perforated Mineral Tile Ceilings Provide Air Distribution and Acoustical Treatment

WHEN THE ARMSTRONG CORK COMPANY DECIDED TO air condition its general office building in Lancaster, Pa., a unique system of equalizing air diffusion and temperature was developed employing the company's own ceiling products.

The air conditioning plan for the four-story, 220,000 sq ft structure incorporates the use of suspended, perforated mineral tile ceilings for the dual purpose of acoustical treatment and air diffusion.

The system was made possible by drilling small holes through various types of mineral acoustical materials to allow air to enter a room at equal pressure and temperature through these small openings in the ceiling surface.

Intended mainly as an experiment to test the efficiency of perforated mineral tile ceilings as air diffusers, the system proved highly economical to install. Besides providing acoustical treatment and improved air circulation, it saved the company thousands of dollars by eliminating standard diffusers and a considerable amount of duct work. Only a duct stub was required in each room to discharge the conditioned air into the plenum space above the suspended ceiling.

The concept of using this plenum space as a "pressure chamber" for conditioned air is not new. Neither is the idea of diffusing air through the ceiling. However, Armstrong's general office is the first installation to employ these concepts using standard mineral tile ceilings as air diffusers. The advantage of this, first of all, is that the diffuser holes in the tile are not noticeable, since they fit in with the overall design pattern of the ceiling. Secondly, it effectively eliminates noise, drafts and "cold spots," sometimes associated with other types of diffuser systems.

Eugene D. Scribner, a member of the company's central engineering department, is credited with having first conceived the idea. He admits, "Our original intention was to try this concept with a metal pan type of ceiling. However, since Armstrong manufactures the mineral acoustical tile, and merely markets the metal pan type, it was decided to experiment with the mineral tiles for the general office application. Now after 8 months of successful operation, we are convinced that similar type systems are practical for a wide variety of air conditioning projects, both in new and remodeled buildings."

Stub duct in each room is equipped with a reheat coil which warms air to desired temperature before it is discharged into plenum space above perforated acoustical tile ceiling.

Fissured mineral acoustical tile, partially perforated to allow air to pass through, was installed in a standard suspension system.

Presently in use in the general office are two different incombustible mineral acoustical materials — Full Random Minatone, and Fissured Travertone — both manufactured by Armstrong. The small air diffuser holes going through these materials have very little effect on their acoustical qualities. In fact, as Mr. Scribner points out, the individual offices are generally quieter since most of the noise from the air conditioning is absorbed by the ceiling.

The new system also made it possible to lower the ceilings in most areas of the building, providing a more attractive and modern appearance. The original plaster ceilings were approximately 12 to 18 inches higher than the present ceiling level.

In the general office system, air is recirculated with 25% new air added. The air is discharged into the rooms where individual room thermostats are located. The thermostat regulates a booster heater coil in the stub duct to provide individual room temperature control. The cool air leaves the central cooling system at 58 deg F, and is warmed to the desired temperature by the booster heater before it passes down through the ceiling. Average air flow through the ceiling is 1.56 cfm per sq ft, representing a pressure of 0.005 inches of water.

The hot water heating system used in the building for many years was left intact to provide supplemental heat in the winter. According to Mr. Scribner, the booster heater coils in the air conditioning system provide enough heat so that the hot water system need not be used until the outside temperature drops below 40 deg. He feels that "total" winter heating is also possible with this type of system if the air returns are strategically placed at floor level.

Mr. Scribner's ideas were presented to C. S. Leopold, Inc., of Philadelphia, consulting engineers, who incorporated the new air diffusion concept when designing the system and writing the final specifications.

B. & G. Olsen Co., Richmond, Va., was the air conditioning contractor. Two hermetic type centrifugal compressors, each with a 500-ton capacity, were supplied by Carrier Corporation. Cooling towers were provided by Marley Corporation, Kansas City, Mo.

Roof-Mounted Units Speed Industrial Year-Round Installation

A RECENT ROOF-MOUNTED INSTALLATION AT THE Diecraft Inc., factory building in Sparks, Md., demonstrates some of the advantages of a factory assembled and tested system. Delivered and put in place in one day, this 300-ton system was in operation the next. Avoided for this single-story industrial building were the delays and problems inherent in installations of conventional systems with their piping, ductwork and insulation, and the necessity of coordinating the activities of all the trades.

This type of installation is called a new stage in the increasing use of prefabricated components in the year-round conditioning of one-story commercial and industrial buildings. According to George A. Belsky, general manager of Air Conditioning Inc., Ossining, N. Y., new units added to the company's Atmos-Pak line make it possible to satisfy the needs of almost every size and type of single-story commercial and industrial building.

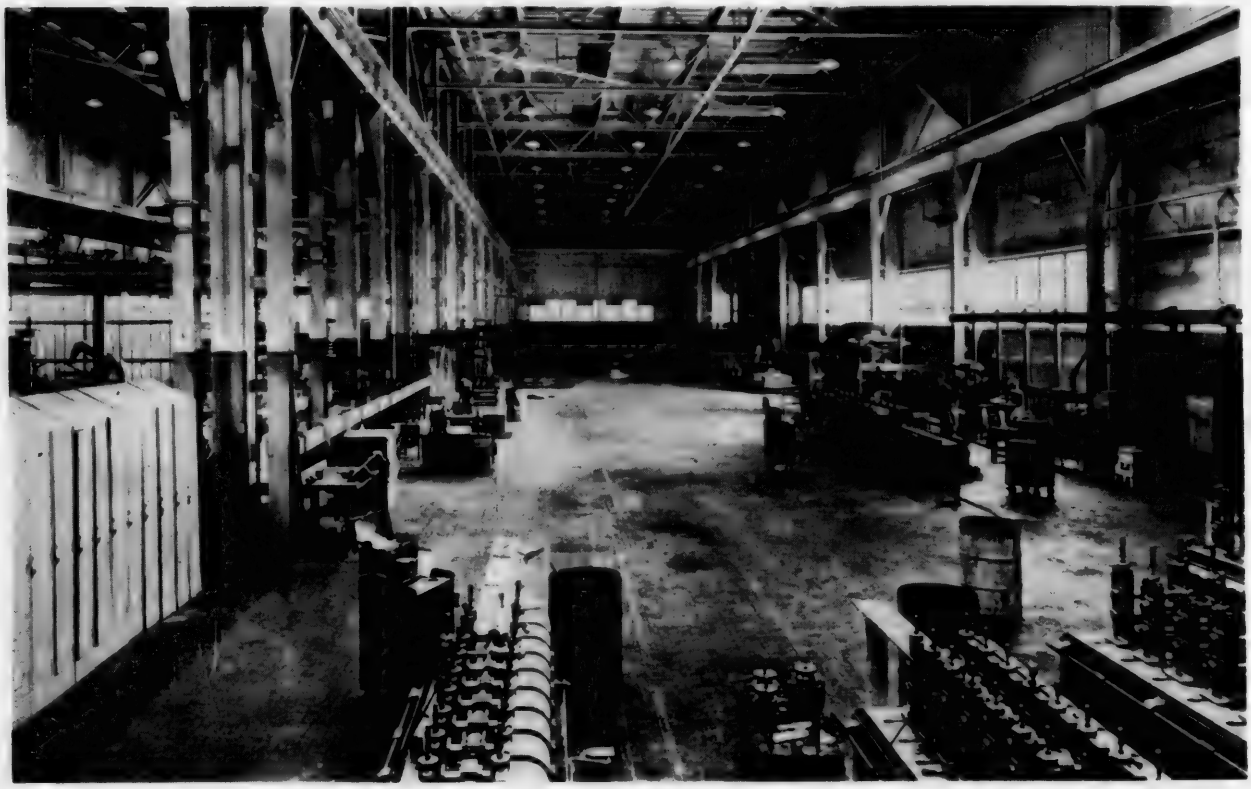
The air-cooled roof-mounted method, the company points out, releases space for the productive purposes of tenant or owner since there are no boiler or apparatus rooms. The air is handled by a supply and return air distribution chamber so that ducts are eliminated. Water towers and evaporative condensers, with their necessary mazes of pipes and appurtenances, are not needed. With multiple units there is economy of operation, control becomes flexible, and the danger of total breakdown is removed.

Twenty 15-ton units in the Diecraft installation provide zoning for the various departments without a complicated automatic system, it is reported. The air supply and return distribution chambers in this system ensure good air distribution, and are said to improve zoning by returning secondary air at the same point where primary air is introduced.

This type of system is highly adapted to winter operation with gas or oil fueled heat exchangers which are available. Where there already is a boiler plant, hot water or steam coils can be incorporated into the roof-mounted system.

Equally suitable for new or existing structures, these roof-top systems are said to be comparable in cost with other methods. And, taking all factors into consideration, Mr. Belsky reports, "I believe that there are now no restrictions on the possibilities of expanding air conditioning capacity with this type of prepackaged system."

Forty feet above the floor, gas-fired infra-red heaters are equipped with parabolic reflectors that focus the rays in a concentrated pattern. Majority of units are mounted along the perimeter, angled away from the wall to direct energy rays in a spread pattern over floor, men, and machinery at new metal forming machinery plant.



Infra-Red Heaters Burn Less Gas than Estimated

YODER COMPANY'S NEW METAL FORMING MACHINERY plant in Cleveland, Ohio, that boasts a gas-fired infra-red heating system, keeps the plant at a constant 68 deg F in winter and uses only two-thirds of the fuel estimated.

Estimated fuel consumption for the infra-red system installed in the plant was 8.44 million cu ft of natural gas. Ninety-nine Schwank heaters did better than expected in the first heating season. *Actual* gas consumption measured between September 16, 1958, and May 10, 1959, was only 5.577 million cu ft — 2.963 million cu ft less than the estimate. Actual costs for natural gas totaled $3722 for the period; actual degree-days were 5455 on a 63-deg base.

The Yoder plant is walled with stainless steel sandwich that includes 1½-inch insulation and is roofed with 4-inch pre-cast concrete and ¾-inch rigid insulation. Building space totals 1,581,000 cu ft, divided among the 100 × 380 × 40 ft plant area, a 30 × 60 × 18 ft truck dock as well as a 40 × 40 × 18 ft compressor room.

Infra-red heaters were mounted at heights of 16, 18 and 40 ft. Heaters installed have an input of 4,488,000 Btuh. Heat loss for the building was estimated as 3,740,000 Btuh.

Heaters are approved by AGA and Underwriters' Laboratories for unvented use in non- and semi-hazardous areas; combustion gases contain a lower percentage of carbon monoxide than that produced by a kitchen gas range, according to the manufacturer, Perfection Div., Hupp Corp., Cleveland.

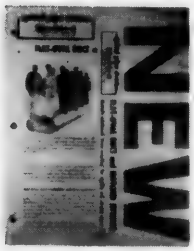
Thermostatic control of infra-red heaters is provided. At the Yoder plant, separate thermostats control groups of heaters, allowing more precise temperature adjustment in each area of the plant. Thermostats react to air temperature rather than radiant heat output of the heaters. Radiation from the units absorbed by the floor and machinery in the plant warms surrounding air by convection and conduction. Burners operate only intermittently as the floor and machinery form a reservoir of heat energy.

Two additional advantages pointed out by L. W. Morgan, plant engineer, are low maintenance and elimination of warm-up period. Not having to heat the air in the plant to produce comfort, the infra-red heaters do not require the 4-5 hr warm-up period which conventional apparatus require.

Without blowers, ducts, and heat exchangers, maintenance of heating equipment is minimal. Electrical costs for the heating season for infra-red units were calculated at only $15 because power is required only for the controls.

NEW LITERATURE

Use the prepaid yellow postcard in the back of the magazine for securing your copies of these catalogs.



Flat-Oval Duct and Fittings

United Sheet Metal Co., Inc., Columbus, Ohio, has developed flat-oval duct and fittings for use where space limitations prevent the installation of circular duct for high-pressure, high-velocity air systems. A 5-page bulletin lists sizes, pressure loss and other selection data.

Circle **Item 1** on Inquiry Card

Gas-Fired Chiller-Heater

Arkla Air Conditioning Corp., Little Rock, Ark., offers a 24-page booklet on the Arkla Model DF-3000 gas-fired water chiller-heater. Technical data on this medium tonnage absorption unit include specifications, capacities and operating details, and piping and electrical diagrams.

Circle **Item 2** on Inquiry Card

Pressure Tanks and Vessels

A 4-page brochure covering its industrial pressure tanks and vessels is available from Industrial Tank Div., Cutler Metal Products Co., Camden, N. J. Photos, engineering drawings and representative dimensional tables help to describe ASME air pressure and expansion-compression tanks.

Circle **Item 3** on Inquiry Card

Government Buildings

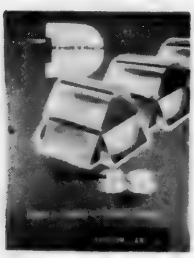
Government Buildings, one of an installation series published by Ray Burner Co., San Francisco, Calif., details use of the company's forced draft combination and gas burners in the Sedgwick County Courthouse, Wichita, Kan. Specifications and details of installation are included.

Circle **Item 4** on Inquiry Card

Direct-Operated Solenoid Valves

Direct-operated solenoid valves for automatic or remote flow control of liquids and steam up to 400 deg F are described by The Johnson Corp., Three Rivers, Mich., in 12-page Bulletin V-6. Coverage for each valve includes sizes, dimensions, capacities and accessories.

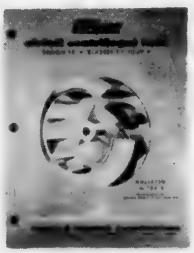
Circle **Item 5** on Inquiry Card



Roof Exhaust Fans

Type SS roof exhaust fans, designed by Davidson Fan Co., Newton, Mass., for versatility and dependable performance, are the subject of 4-page Bulletin No. SS-101. Included are construction features, dimension and capacity tables, and photos of typical applications.

Circle **Item 6** on Inquiry Card



Airfoil Centrifugal Fans

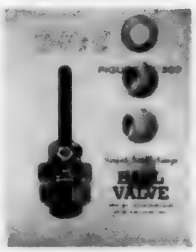
Airfoil Design 10 centrifugal fans, a new line of ventilating and air conditioning system fans now available from Chicago Blower Corp., Franklin Park, Ill., are described in 8-page Bulletin A-104-S. Included are design features and performance characteristics for standard and heavy-duty units.

Circle **Item 7** on Inquiry Card

Plant Safety System

The new plant safety system developed by The North American Mfg. Co., Cleveland, Ohio, for plants using gas is described in literature comprising Bulletins 22 and 18.57, and Supplemental Bulletin 22. Mainsprings of this system are safety shutoff valves and supervising gas cocks.

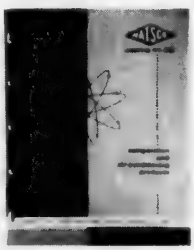
Circle **Item 8** on Inquiry Card



New Ball Valve

Four-page Bulletin DH-38, issued by R-P&C Valve Div., American Chain & Cable Co., Inc., Reading, Pa., describes its new Fig. BL-300 forged naval bronze ball valve with "automating" seats. Bulletin includes a cross-section of valve that is keyed to specification tables.

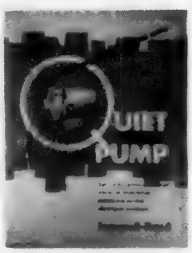
Circle **Item 9** on Inquiry Card



Refrigeration Products

Twenty-page Catalog No. 22, published by Watsco, Inc., Hialeah, Fla., portrays the company's lines of refrigeration and air conditioning products. These include valves, accumulators, capacity tester, door gasket notcher, compressor gaskets, liquid leak detector, and many others.

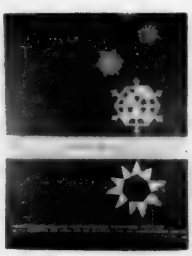
Circle **Item 10** on Inquiry Card



Centrifugal Motor-Pump

Information on its new, quiet-running motor-pump is presented in a 4-page bulletin by Ingersoll-Rand Co., New York, N. Y. Form 70287 describes the 1750K-Line Motorpump, designed with 1750-rpm operating speed for air conditioning, heating and general services.

Circle **Item 11** on Inquiry Card



All Weather Systems

Climate King all weather systems, 7.5 tons and up, are described in 12-page Form No. 4-5-60 by Pioneer Industries, Div. of Almar-York Co., Inc., Fort Worth, Tex. Included are year-round deluxe heating units, gas-fired, for use with remote air cooled or water cooled condensing units.

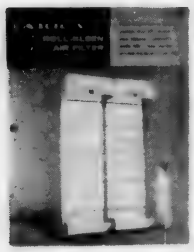
Circle **Item 12** on Inquiry Card

Use the prepaid yellow postcard in the back of the magazine for securing your copies of these catalogs.

Exhaust Heads

Industrial Products Group, Crane Co., Chicago, Ill., announces literature describing Crane-Swartwout exhaust heads. Two-page Form AD-2438 gives dimensions, weights and capacities for the heads which are designed to remove impurities from exhaust steam being discharged to the atmosphere.

Circle **Item 13** on Inquiry Card



Roll-Type Air Filter

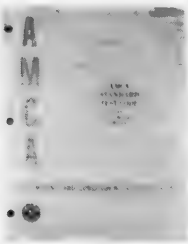
An 8-page bulletin issued by Farr Co., Los Angeles, Calif., describes the firm's redesigned V-7 Roll-Kleen air filter. Selection data are included for 4 models which offer a choice of automatic drive or manual operation for advancing media across the face of the filter.

Circle **Item 14** on Inquiry Card

Ductile Iron Valves and Fittings

A 12-page catalog describing its line of ductile iron valves and fittings is available from Stockham Valves & Fittings, Birmingham, Ala. The comprehensive catalog, No. 1, includes design features, weights, dimensions, engineering specifications, and physical and chemical properties.

Circle **Item 15** on Inquiry Card



Standard Test Code

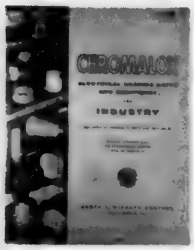
The Air Moving and Conditioning Association, Inc., Detroit, Mich., announces that a new Standard Test Code covering all air moving devices is now available as AMCA Bulletin No. 210. Features incorporated in the 1960 Code include nozzle test methods and the effect of compressibility.

Circle **Item 16** on Inquiry Card

Room Thermostats

A contemporary-styled series of room thermostats is the subject of a 4-page bulletin, Unit R-1691, published by White-Rodgers Co., St. Louis, Mo. Included are selection data for the company's D'luxline and Mainline thermostats and Push-Button heating-cooling control.

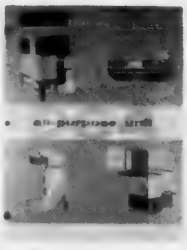
Circle **Item 17** on Inquiry Card



Industrial Electric Heating

As an appendix to its current Chromalox industrial electric heating catalog, No. 60, Edwin L. Wiegand Co., Pittsburgh, Pa., announces Catalog Supplement CS-600. It contains illustrations and specifications of air heating elements, blower-type heaters, special radiant heaters, others.

Circle **Item 18** on Inquiry Card



Industrial Heating Unit

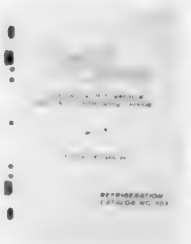
The new dual-fuel OG4 series, described in a 12-page bulletin by Lennox Industries Inc., Marshalltown, Iowa, can be used as a central furnace, unit heater with directional discharge nozzles, or duct furnace with performance capabilities for the future addition of industrial air conditioning.

Circle **Item 19** on Inquiry Card

Electrical Equipment

A 424-page guide to its lines of electrical equipment is offered by The Wadsworth Electric Mfg. Co., Inc., Covington, Ky. It is designed to facilitate selection, for residential through industrial installations, of safety switches, service equipment, distribution panels, etc.

Circle **Item 20** on Inquiry Card



Commercial Refrigeration Equipment

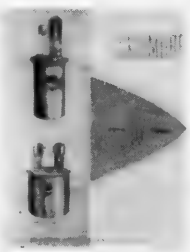
What is described as the most complete line of commercial refrigeration equipment available throughout the industry is the subject of a 16-page catalog, No. 103, published by McQuay, Inc., Minneapolis, Minn. Detailed information on specifications, capacities and accessories is included.

Circle **Item 21** on Inquiry Card

Installation Guide

A revised edition of its Installation Guide for Transite Pressure Pipe is announced by Johns-Manville Corp., New York, N. Y. The 124-page pocket-sized manual covers all phases of handling and installation, and includes engineering data on site and soil conditions.

Circle **Item 22** on Inquiry Card



Condensation Pumps

Two new bulletins containing complete information and technical data on condensation pump sizes, capacities and pressures are offered by Skidmore Corp., St. Joseph, Mich. Bulletin No. 19-B describes Type UV single and duplex units; No. 21-C, Type CCVS (close-coupled design).

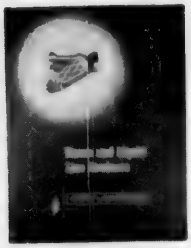
Circle **Item 23** on Inquiry Card

Commercial Water Heating

A hard cover, loose-leaf manual which presents simplified sizing procedures for the entire commercial water heating field is offered by Republic-Transcon Industries, Inc., Beverly Hills, Calif. Areas covered include multiple dwellings, motels and hotels, industrial plants, etc.

Circle **Item 24** on Inquiry Card

Use the prepaid yellow postcard in the back of the magazine for securing your copies of these catalogs.



Line Strainers

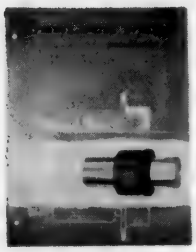
A 4-page guide to the selection of line strainers for steam and liquid is offered by OPW-Jordan Corp., Cincinnati, Ohio. Bulletin J-LS includes tips for better strainer performance, recommends the type of mesh to use, and lists the various strainer sizes and materials of construction.

Circle **Item 25** on Inquiry Card

Evaporative Condensers

Fourteen-page Bulletin 143 is a complete revision of the evaporative condenser engineering manual published by Baltimore Aircoil Co., Inc., Baltimore, Md. Includes general theory and design, selection data, piping arrangements, summer and winter operation, and capacity control.

Circle **Item 26** on Inquiry Card



Mechanical Seals

An 8-page bulletin published by Garlock Inc., Palmyra, N. Y., describes the company's Mechanipak mechanical seals for rotary shafts and pressures up to 150 psi. Bulletin contains construction features, specifications and dimensions, and useful selection and installation information.

Circle **Item 27** on Inquiry Card

Cooling Tower Pumps and Piping

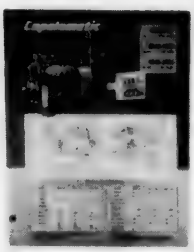
A 6-step, 8-page guide, Bulletin No. CT-360, to help designers of cooling tower installations plan their pump and piping requirements is available from Bell & Gossett Co., Morton Grove, Ill. Selection aids include design tables and charts, piping diagrams, and a full-page work sheet.

Circle **Item 28** on Inquiry Card

Steam Heating Coils

A 24-page booklet on steam heating coils is available from Sturtevant Div., Westinghouse Electric Corp., Hyde Park, Mass. Catalog 1710 includes application information on blast heating coils, distributing tube heating coils, and dual-feed distributing tube coils.

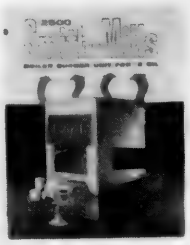
Circle **Item 29** on Inquiry Card



Motor-Compressors

Two brochures, covering performance data and specifications for new 4- and 6-cylinder Copelametic motor-compressors, are announced by Copeland Refrigeration Corp., Sidney, Ohio. Models extend low-temperature range to 7.5 and 10 hp, and high-temperature range through 30 hp.

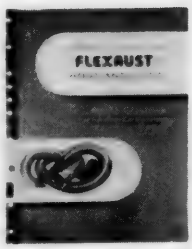
Circle **Item 30** on Inquiry Card



Boiler-Burner Unit

The Smith-Mills 2500 boiler-burner unit for medium sized buildings with No. 2 fuel oil is the subject of a 4-page bulletin published by The H. B. Smith Co., Inc., Westfield, Mass. Bulletin includes construction features, specs and dimensions, standard and extra equipment.

Circle **Item 31** on Inquiry Card



Flexible Hose and Duct

Bulletin 605 describes flexible hose and duct manufactured by The Flexaust Co., New York, N. Y. Flexaust hose and Portovent duct are designed for use in dust collection, fume control, air and materials handling applications of all kinds. Complete selection and pricing data included.

Circle **Item 32** on Inquiry Card

Storage Water Heaters

Niagara Weldments Inc., Niagara Falls, N. Y., offers an 8-page bulletin which introduces a new line of storage water heaters under the tradename "NiaWel". Specifications and selection data cover vertical and horizontal models, plus removable U-tube heating elements.

Circle **Item 33** on Inquiry Card

Air Handling Units

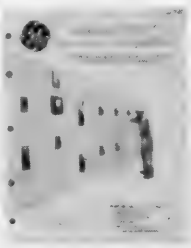
A 4-page bulletin from Thermal Engineering Corp., Houston, Tex., describes its line of Thermal EC air handling units which are reported to provide efficient, quiet heating and cooling for small stores, restaurants, offices and apartments. Includes complete selection data.

Circle **Item 34** on Inquiry Card

Vertical Exhaust Ventilator

A 2-page bulletin, DB3-300, offered by Ilg Electric Ventilating Co., Chicago, Ill., provides complete data on the company's new high-speed, high-capacity, Type UB (up-blast), vertical exhaust roof ventilator. Charts include data on performance, sound level classification, dimensions.

Circle **Item 35** on Inquiry Card



Power Centers

Cabinetrol power centers, subject of 12-page Bulletin GEA-7080, are engineered to customer specifications by General Electric Co., Schenectady, N. Y. Bulletin tells how this industrial power center centralizes such functions as motor control, lighting, and air conditioning.

Circle **Item 36** on Inquiry Card

DEGREE-DAYS FOR DECEMBER, 1960

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city

AIR CONDITIONING, HEATING AND VENTILATING's 33rd Year of Publication of Monthly Degree-Day Data

City	December			Season to Dec. 31, incl., from Sept. 1		
	1960	1959	Normal	1960	1959	Normal
Abilene, Texas (A)	739	520	595	1058	1164	1098
Albany, New York (A)	1338	1080	1197	2614	2435	2559
Albuquerque, New Mexico (A)	956	827	899	1763	1725	1757
Alpena, Michigan (C)	1387	1146	1218	3051	3067	2827
Anchorage, Alaska (A)	1226	1450	1587	3883	4203	4277
Asheville, North Carolina (C)	931	747	769	1679	1553	1633
Atlanta, Georgia (A)	744	575	614	1185	1100	1125
Atlantic City, New Jersey (C)	1007	748	831	1744	1553	1597
Augusta, Georgia (A)	733	527	494	1122	946	835
Baltimore, Maryland (C)	1015	704	812	1618	1462	1537
Billings, Montana (A)	1067	950	1172	2469	2767	2739
Binghamton, New York (C)	1289	929	1113	2497	2052	2417
Birmingham, Alabama (A)	723	525	596	1168	1052	1128
Bismarck, North Dakota (A)	1488	1197	1535	3343	3475	3458
Block Island, Rhode Island (A)	1021	825	927	1913	1765	1936
Boise, Idaho (A)	1063	1142	1054	2230	2723	2340
Boston, Massachusetts (A)	1094	885	998	2035	1894	2008
Buffalo, New York (A)	1339	1004	1116	2520	2287	2424
Burlington, Iowa (A)	1193	932	1150	2227	2406	2334
Burlington, Vermont (A)	1399	1200	1308	2961	2791	2859
Cairo, Illinois (C)	946	684	784	1572	1542	1465
Charleston, South Carolina (C)	651	424	410	835	687	658
Charlotte, North Carolina (A)	809	633	682	1313	1205	1274
Chattanooga, Tennessee (A)	877	651	710	1520	1337	1380
Cheyenne, Wyoming (A)	1176	978	1125	2725	2900	2840
Chicago, Illinois (A)	1225	898	1147	2209	2305	2352
Cincinnati, Ohio (C)	1049	748	880	1719	1674	1711
Cleveland, Ohio (A)	1299	894	1057	2464	2089	2171
Columbia, Missouri (A)	1042	826	989	1814	2014	1967
Columbia, South Carolina (A)	728	550	524	1130	999	908
Columbus, Ohio (C)	1199	841	983	2077	1945	1995
Concord, New Hampshire (A)	1363	1100	1271	2848	2547	2839
Concordia, Kansas (C)	1028	842	1029	1907	2142	2048
Dallas, Texas (A)	639	423	518	921	956	870
Denver, Colorado (A)	1187	876	1032	2432	2400	2348
Des Moines, Iowa (A)	1202	957	1203	2338	2593	2455
Detroit, Michigan (A)	1228	933	1101	2285	2278	2325
Devils Lake, North Dakota (C)	1704	1319	1668	3678	3936	3795
Dodge City, Kansas (A)	992	849	980	1861	2057	1951
Dubuque, Iowa (A)	1381	1043	1290	2726	2891	2765
Duluth, Minnesota (A)	1626	1279	1550*	3530	3758	3533*
El Paso, Texas (A)	806	573	626	1249	1045	1086
Ely, Nevada (A)	1183	1205	1181	2777	3036	2864
Escanaba, Michigan (C)	1406	1102	1321	2962	3049	3056
Evansville, Indiana (A)	1060	780	871	1872	1815	1715
Fairbanks, Alaska (A)	1844	2316	2297	5710	5966	5929
Fargo, North Dakota (A)	1701	1205	1615	3508	3506	3538
Fort Smith, Arkansas (A)	(a)	608	698	(a)	1336	1273
Fort Wayne, Indiana (A)	1276	925	1122	2399	2321	2365
Fort Worth, Texas (A)	658	450	533	956	988	890
Fresno, California (A)	656	571	580	1146	923	1011
Galveston, Texas (C)	371	248	271	462	511	402
Grand Junction, Colorado (A)	1077	1007	1132	2128	2332	2293
Grand Rapids, Michigan (A)	1269	987	1169	2460	2525	2597
Green Bay, Wisconsin (A)	1408	1128	1392	2978	3130	3035
Greensboro, North Carolina (A)	929	726	772	1617	1508	1513
Greenville, South Carolina (A)	781	632	648	1257	1237	1200
Harrisburg, Pennsylvania (A)	1216	895	964	2139	1917	1971
Hartford, Connecticut (A)	1227	1013	1082	2411	2183	2266
Havre, Montana (C)	1351	1025	1383	3062	3148	3240
Helena, Montana (A)	1266	1112	1311	3014	3334	3247
Houston, Texas (C)	402	266	303	529	569	465
Huron, South Dakota (A)	1523	1096	1407	3230	3143	3003
Indianapolis, Indiana (A)	1245	895	1051	2263	2198	2141
Jackson, Mississippi (A)	626	498	503	973	979	882
Juneau, Alaska (A)	956	926	1159	2997	3002	3312
Kansas City, Missouri (A)	1046	956	970	1761	1865	1875
Knoxville, Tennessee (A)	917	687	744	1544	1391	1454
La Crosse, Wisconsin (A)	1342	1057	1380	2726	2939	2900
Lander, Wyoming (A)	1380	1206	1383	3128	3270	3309
Lewiston, Maine (O)	1318	1088	1295	2811	2559	2837

a) Data not available.
* Figures based on Airport readings.
** Figures based on City office readings.
Normal figures in this table are based on 30-year period covering 1921 to 1950, inclusive, as compiled and published by the U. S. Weather Bureau.

Figures in this table, with two exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Co., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively.

Degree-Days for December, 1960 (Concluded)

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city

AIR CONDITIONING, HEATING AND VENTILATING'S 33rd Year of Publication of Monthly Degree-Day Data

City	December			Season to Dec. 31, incl., from Sept. 1		
	1960	1959	Normal	1960	1959	Normal
Lincoln, Nebraska (C)	1087	895	1113	2098	2326	2243
Little Rock, Arkansas (A)	841	562	654	1375	1211	1179
Los Angeles, California (C)	194	145	253	351	170	451
Louisville, Kentucky (A)	1078	771	871	1924	1665	1733
Lynchburg, Virginia (A)	989	772	809	1736	1586	1625
Macon, Georgia (A)	660	485	481	1000	881	824
Madison, Wisconsin (A)	1361	1046	1287	2795	2878	2707
Marquette, Michigan (C)	1388	1093	1299	2973	3128	3011
Memphis, Tennessee (A)	853	602	673	1382	1260	1248
Meridian, Mississippi (A)	635	522	528	1029	1005	956
Milwaukee, Wisconsin (A)	1312	999	1218	2714	2704	2611
Minneapolis, Minnesota (A)	1490	1073	1414	3138	3040	2990
Moline, Illinois (A)	1277	931	1181	2383	2495	2426
Montgomery, Alabama (A)	655	480	491	1008	873	864
Nashville, Tennessee (A)	931	674	725	1588	1431	1372
New Haven, Connecticut (A)	1138	929	1026	2179	1951	2145
New Orleans, Louisiana (C)	366	274	283	452	522	429
New York, New York (C)	1054	805	908	1804	1684	1771
Newark, New Jersey (A)	1079	832	961	1925	1682	1912
Norfolk, Virginia (A)	877	621	688	1384	1188	1257
North Platte, Nebraska (A)	1162	1000	1172	2519	2826	2563
Oak Ridge, Tennessee (C)	930	727	812	1627	1407	1587
Oakland, California (A)	508	448	508	1063	807	1077
Oklahoma City, Oklahoma (A)	853	644	747	1357	1514	1367
Omaha, Nebraska (A)	1110	923	1166	2159	2419	2368
Parkersburg, West Virginia (C)	1107	820	896	1923	1815	1824
Peoria, Illinois (A)	1278	930	1128	2397	2371	2312
Philadelphia, Pennsylvania (C)	1000	760	856	1639	1546	1624
Phoenix, Arizona (A)	445	342	360	614	487	555
Pittsburgh, Pennsylvania (C)	1133	807	924	1975	1809	1890
Pittsfield, Massachusetts (A)	1375	1139	1246	2820	2633	2845
Portland, Maine (A)	1317	1090	1237	2826	2579	2776
Portland, Oregon (C)	734	680	701	1564	1582	1600
Providence, Rhode Island (A)	1159	942	1035	2231	2041	2195
Pueblo, Colorado (A)	1087	917	1051	2137	2313	2279
Raleigh, North Carolina (A)	874	667	651	1477	1352	1166
Rapid City, South Dakota (A)	1234	949	1218	2632	2946	2802
Reading, Pennsylvania (C)	1143	856	936	1992	1782	1866
Red Bluff, California (A)	570	522	564	1000	799	942
Reno, Nevada (A)	1015	1096	986	2382	2481	2338
Richmond, Virginia (A)	936	718	791	1656	1501	1532
Rochester, New York (A)	1280	1052	1141	2462	2391	2473
Roswell, New Mexico (A)	1102	692	750	1797	1490	1415
Sacramento, California (C)	572	559	567	996	928	980
St. Joseph, Missouri (A)	1077	858	927	1995	2175	1809
St. Louis, Missouri (C)	958	760	893	1659	1755	1703
Salt Lake City, Utah (A)	1088	1142	1039	2254	2548	2279
San Antonio, Texas (A)	457	336	374	612	737	600
San Diego, California (A)	261	150	255	415	184	478
Sandusky, Ohio (C)	1218	893	1039	2177	2108	2116
San Francisco, California (C)	415	307	406	1001	599	881
Sault Ste. Marie, Michigan (A)	1489	1236	1398	3215	3313	3340
Savannah, Georgia (A)	607	463	412	834	754	675
Scranton, Pennsylvania (A)	1331	1012	1057	2569	2288	2254
Seattle, Washington (C)	675	660	679	1655	1696	1682
Sheridan, Wyoming (A)	1194	1101	1271	2841	3187	3045
Shreveport, Louisiana (A)	626	442	490	918	965	848
Sioux City, Iowa (A)	1224	1000	1290	2425	2742	2708
Spokane, Washington (A)	1186	1113	1113	2728	3002	2705
Springfield, Illinois (A)	1209	865	1017	2124	2121	1998
Springfield, Missouri (A)	1003	773	908	1734	1879	1833
Syracuse, New York (A)	1273	1045	1113	2446	2339	2340
Toledo, Ohio (A)	1317	983	1119	2491	2450	2364
Topeka, Kansas (C)	1044	830	977	1900	2106	1891
Trenton, New Jersey (C)	1104	837	930	1924	1737	1852
Tulsa, Oklahoma (A)	814	619	750	1295	1417	1382
Utica, New York (O)	1198	991	1144	2183	2164	2537
Valentine, Nebraska (A)	1278	1017	1212	2739	3051	2709
Walla Walla, Washington (C)	1039	915	890	1996	2132	1966
Washington, D. C. (A)	1048	704	831*	1756	1495	1604*
Wichita, Kansas (A)	991	747	915	1720	1836	1763
Williston, North Dakota (C)	1471	1153	1528	3282	3502	3495
Winnemucca, Nevada (A)	1071	1225	1085	2493	2838	2595
Yakima, Washington (A)	1164	1011	1066	2539	2553	2469

For footnotes, see page 140.

Use the convenient prepaid yellow postcard in the back of the magazine for securing more information about new equipment and materials described in this department.

Add Humidity Control to Line

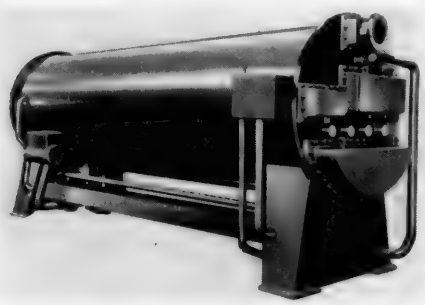
Edwin L. Wiegand Company, Pittsburgh, Pa., has announced the addition of a highly sensitive humidity control to its Chromalox temperature control line. Designated type HC-842, the device is designed to control humidity in conjunction with Chromalox electric comfort heating equipment.

Control may be used to operate an exhaust fan which discharges moist air and draws in outside air to replace it. This operation balances the humidity to the pre-set level of the unit. It has a range of 10% to 100% with a 4% differential. It is rated 125 va for 115/230 volt a-c and 45 va for 115 volt d-c.

More Information? Circle Item 37 on Inquiry Card.

Absorption Line Expanded

Three new sizes of absorption Cold Generators, in capacities of 400, 455, and 530 tons, are announced by The Trane Company, La Crossse, Wis. The new units expand the line to twelve basic sizes in the 100-530 ton range.



The three new sizes feature the same single-shell, hermetic design as the original nine sizes introduced in 1959. The single-shell arrangement reduces machine height, permitting installation in low-ceiling areas, the company says. Hermetic design prevents air leakage, thus maintaining full-rated capacity and resisting internal oxidation.

More information? Circle Item 38 on Inquiry Card.

Improves Pipe Tape

Arno Adhesive Tapes, Inc., Michigan City, Ind., is producing an improved version of its C-350 Polyethylene Pipewrap tape used to protect pipes, conduit and other metal surfaces from corrosion due to soil burial, water, acids, alkalies, in addition to other contaminants.

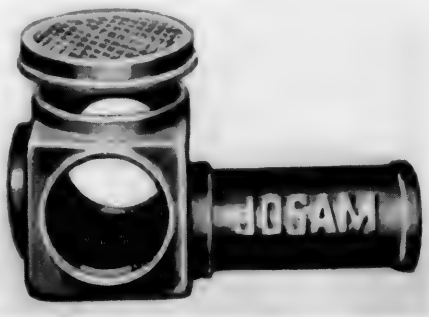
The tape's adhesion has been increased to 40 oz per inch width and its tensile strength to 20 lb per inch width. Insulation resistance is now 1,000,000 megohms. Moisture vapor transmission rate has been reduced to 18 grams per 100 inches in 24 hours.

The 10-mil black polyethylene tape has an aggressively tacky, pressure-sensitive rubber base that, with its light weight, makes it easy to handle. The tough, stretchy film provides maximum protection against chemical and corrosive attack while maintaining a continuous covering over all surface irregularities.

More Information? Circle Item 39 on Inquiry Card.

Improved Drain Tile Receiver

Series 1780 drain tile receiver, offered by the Josam Mfg. Co., Michigan City, Ind., offers important advantages when used as a junction box for a tile field under a building by making it possible to clean the system when desirable, also to insure dry and maintenance-free sub-elevations. It exhausts to either storm or sewer, prevents clogging and inundation problems which occur at the sub-elevations or wall of the structure.



Receiver, suited for installation at the intersection of each series of laterals and the main tile branch, is available with cast iron, bronze or nikaloy cover to fix it to either rough or finished sub-elevation areas; has zero downstream pitch, which enables contractor to hold a minimum grade into his sump, catch basin or sewer only as required by the incline of the system, even though the structure may be of great length.

Design insures access to maintain and hose down a tile field in case there is a clogging in a lateral, branch or bleeders, without the expense of breaking up the floor walls.

More Information? Circle Item 40 on Inquiry Card.

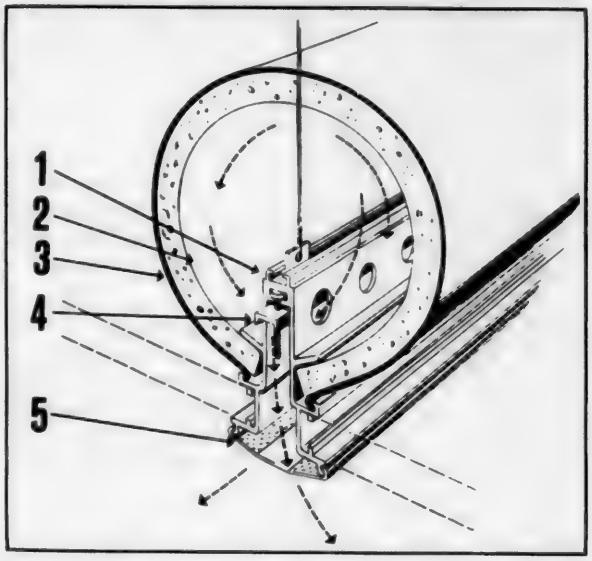
Ceiling Air Distribution System Provides Complete Package Installation

Fiberglas Acousti-Flo System, a new low-velocity method of introducing conditioned air into a room, has been developed by Owens-Corning Fiberglas Corp., New York, N. Y. This air distribution system combines a Fiberglas air supply tube with a perforated metal bar diffuser which distributes the air evenly throughout a room.

System was designed to combine the positive delivery of air through self-insulated tubes with full wall-to-wall diffusion which practically eliminates "dead air spots." The result is reported to be a low cost, attractive ceiling installation. Air delivery through this new system is uniform and is easily controlled by adjusting the continuous dampers.

System also functions as a support for a variety of ceilings, including the luminous type. Therefore, it makes possible a complete ceiling "package" installation which will provide built-in air distribution, noise control, thermal efficiency, and lighting.

The accompanying photo is a typical installation and illustrates how this air distribution system combines with and supports a luminous and acoustical ceiling. The line drawing shows the basic parts of the system which are:



1. The bar. This supports the Acousti-Flo air supply tube, the suspended ceiling, and distributes air uniformly along its entire length. It is a semi-hollow aluminum extrusion, 15 ft long, which is hung directly from the structure above by wire or pencil rod hangers, 6 ft on centers or as required by local conditions A sliding hanger clip supports the system and provides a means for leveling the bar.

2. The air supply tube. This tube conveys the conditioned air. It is insulated to reduce heat loss or gain, and absorb air noise. Tube is available in 3-ft long sections of inside diameters up to 14 inches.

3. The jacket. Exterior protective jacket and vapor barrier is a 0.012-inch thick aluminum alloy sheet. It is furnished with turned-up flanges on both longitudinal edges that snap into lips on the bar.

4. The damper. An extruded aluminum channel installed within the bar controls the air flow from the duct to the bar. Screwdriver slots in the supporting damper bolts allow easy raising and lowering for minute adjustment.

5. The bar cap. A perforated, rolled aluminum section designed to snap off and on the Acousti-Flo bar for cleaning or for access to the dampers. Cap is standard anodized aluminum finish and can be furnished in color.

More Information? Circle Item 41 on Inquiry Card.

Gas-Powered Air Conditioners

Three air conditioning systems (3, 10, and 15-ton units) have been developed by Gascool Div., Vector Engineering Contractors, Inc., Garland, Tex., to complete a series of natural gas or LP gas powered air conditioning systems for residential or institutional use. Other systems included in the series are the 5 and 7½-ton capacity units now available.

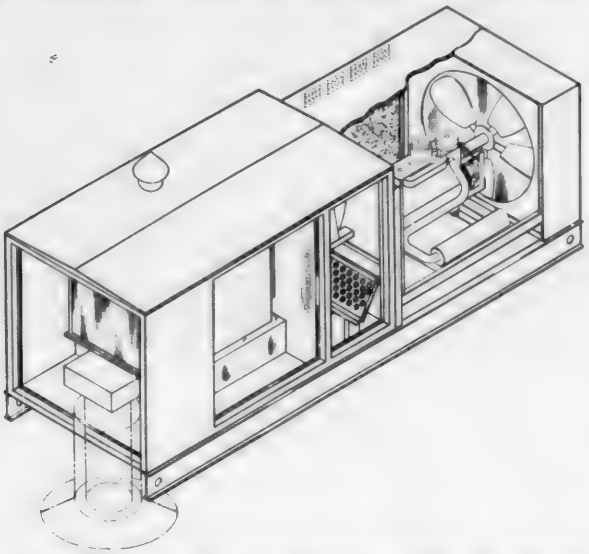
In extensive tests made, the company reports, cost of operating one of these Gascool systems has been proved to be as much as 61% less than comparable (output) systems using other means of power. Lower operating cost is possible, according to the manufacturer, because these units combine tried-and-proven mechanical compressors and long-life engines with the economy of gas fuel.

More Information? Circle Item 42 on Inquiry Card.

Roof-Mounted Combination Unit

Development of a roof-mounted combination heating and cooling unit is announced by Gascool Div., Vector Engineering Contractors, Inc., Garland, Tex.

The system, available in 5-, 7½- and 10-ton sizes, is custom-built to meet any individual air conditioning



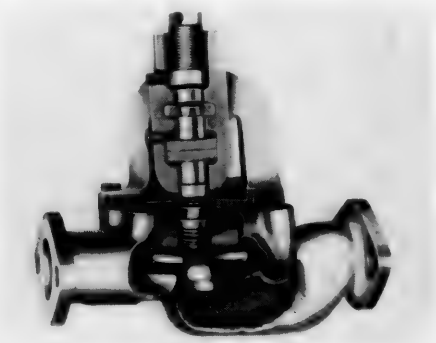
requirement. It can be adapted to meet all heating and air condtiioning needs for stores and offices, hotels, motels, classrooms, public and institutional buildings.

The compact Gascool model, powered by either natural or LP gas, features a series of varying-size combination units operated by individual thermostats. Each unit, due to the individual controls, meets the heating or cooling needs of one particular area of the building, the company reports, thus providing a gentle over-all discharge of air flow and eliminating cool drafts and hot areas.

More Information? Circle Item 43 on Inquiry Card.

Multiple Zone Circulator

Edwards Engineering Corp., Pompton Plains, N.J., announces its Even-Flow circulator, especially designed for modern, multi-zoned circuits.



This circulator features a shut-off head of 14.5 ft of water, a flatter characteristic curve so that more multiple zone circuits can be satisfied with one circulator, and lower power consumption (⅛-hp motor), even though developed heads and flow rates are higher than on conventional circulators, the company asserts. At 10-gpm flow rate, developed head is 13.2 ft, and at 30 gpm, developed head is 10.0 ft.

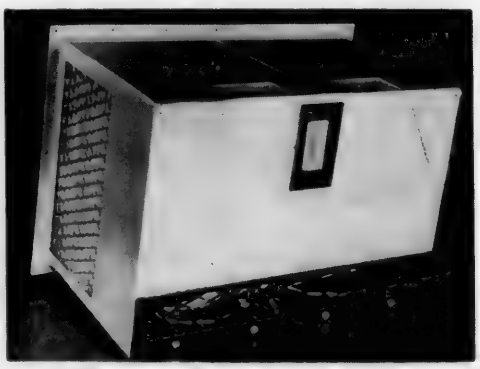
Although the circulator is reported to feature a higher developed head and flow-rate delivery than usual booster pumps and hydronic circulators, it is priced equal to, and in many cases lower than, conventional models.

More Information? Circle Item 44 on Inquiry Card.

118-Lb Air Conditioner

Introduction of a small, 118-lb air conditioner designed specifically for weapon support equipment is announced by Task Corp., 1009 E. Vermont Ave., Anaheim, Calif.

The 1½-ton lightweight unit is described by company spokesmen as occupying less than 4 cu ft, making it well suited for cooling air-transportable electronic equipment such as radar huts, communications trailers and other ground support equipment. Rotating elements operate in the industrial speed zone of 3400 to 3700 rpm for both compressor and fans.



According to the designer of the unit, the use of low speed components has resulted in benefits of low audible noise level, simple maintenance and outstanding reliability. He also states that cost of the unit is substantially below that of contemporary lightweight units now being marketed, and that performance is comparable to larger industrial units.

Latest in the family of Taskline air conditioners, the 1½-ton unit is offered in 60 and 400 cps models. Both models contain the same basic parts, company officials point out, simplifying the stocking of replacement parts at military repair depots. Specifications at MIL spec rated capacity include operation to 125 deg F ambient air, 600 cfm conditioned air flow, and 5.4 kw power consumption under peak operating conditions.

More Information? Circle Item 45 on Inquiry Card.

Oil-Fired Unit Heaters

Manufacture of The Interstate Heater line of oil-fired unit heaters, designated PowRmatic OF, is announced by Kresno-Stamm Corp., Palisades Park, N. J.

These units utilize a gun type burner for No. 2 fuel

oil. Tested and approved by Underwriters Laboratories as a complete unit, they are specially designed for inexpensive installation and operation in warehouses, garages, factories, stores, green houses and other open areas. Outputs are 80,000, 140,000 or 180,000 Btu with deliveries up to 3200 cfm with a 50-ft throw.

More Information? Circle Item 62 on Inquiry Card.

Pipe Guides

Production of a full size range of pipe guides for aligning and supporting piping in which bellows expansion joints and expansion compensators are used is announced by Tube Turns Div., Chemetron Corp., Louisville, Ky.

Made of carbon steel, the guide consists of a guide spider, to be clamped around the pipe whose movement is being controlled, and a guide casing, which can be bolted to base or other supporting structures at any angle. It is available in two standard models, Series A

for up to 1½-inch insulation and Series B for up to 2-inch insulation, from ¾ to 30-inch pipe size. Guides for greater insulation thickness can also be supplied.

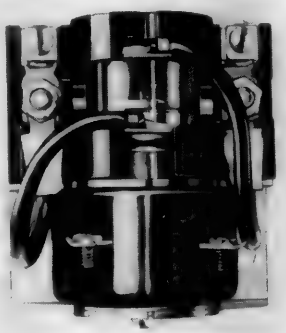
Both series provide for 6 inches of axial movement and are readily adapted to greater traverse by increasing the length of the spider to equal the pipe movement. Guide casings are 3 inches long for pipe sizes 2½ inches and smaller and 6 inches long for sizes 3 inches and larger.

Pipe guides, essential to satisfactory performance of axial movement expansion joints, control the amount of lateral offset and angular rotation to which expansion joints are subjected by changes in pressure and pipe movement, and at intermediate locations, restrict the bowing of the line resulting from end load, the company states. Guides perform a dual function as pipe supports.

More Information? Circle Item 63 on Inquiry Card.

Plunger-Type Mercury Relay

Called silent and chatterless in operation, this new plunger-type mercury relay is seen being particularly suitable for heavy-duty loads such as resistance heating (domestic, industrial and commercial), heat treating furnaces, drying equipment and welding equipment.



Manufacturer, The Mercoid Corp., Chicago, Ill., reports that there is nothing to wear out. Relay contains only one moving part and can provide millions of operations with speeds up to 100 makes or breaks per minute at rated load.

Relay, designated Series W-20-3 (normally open), is described as safe and dependable with no maintenance required. The hermetically sealed contact cannot be affected by dust, dirt, grease, moisture or oxidation.

More Information? Circle Item 64 on Inquiry Card.

Sound Survey Meter

A sound survey meter, described by its maker, Acoustics and Instruments Div., The Korfund Co., Westbury, L.I., N.Y., as highly accurate, inexpensive, rugged, and stable in performance, is fully transistorized and weighs only one pound, including its battery.

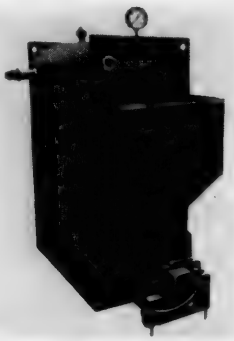
The hand-held instrument is designed for measuring noise levels in factories, offices, and public buildings; assists in locating sources of potentially harmful sound levels, and can be used with its matched pick-up as a vibration meter.

Sound pressure levels from 40-125 db are indicated on its large, legible scale. Frequency response is well within the ASA-specified tolerances in the 45-8000 cps spectrum.

More Information? Circle Item 65 on Inquiry Card.

Volume Water Heaters

Additions to its Series WH gas-fired volume water heater line are announced by Portmar Water Heater Co., Inc., Brooklyn, N. Y. The company has added extended water leg construction with built-in refractory lining. These are said to eliminate building the combustion chamber in the field.

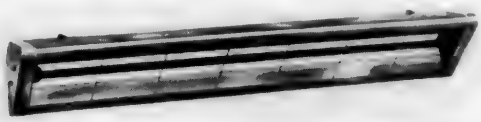


Heaters are available in 14 sizes, delivering 300 to 6,000 gph. Units are self-contained twin coil water heaters which instantaneously supply large quantities of hot water without a storage tank for restaurants, laundries, hotels, motels, schools, and processing plants.

More Information? Circle Item 46 on Inquiry Card.

Indoor, Outdoor Spot Heating

A line of infra-red overhead spot heaters, introduced by Berko Electric Mfg. Corp., Queens Village, N. Y., features a tubular element constructed of Corning's Vycor silica glass, frosted inside and out. This material transmits more than 90% of the infra-red waves generated by the coiled heavy duty alloy element sealed inside. The tube element has very high thermal shock characteristics which make it exceptionally suited for



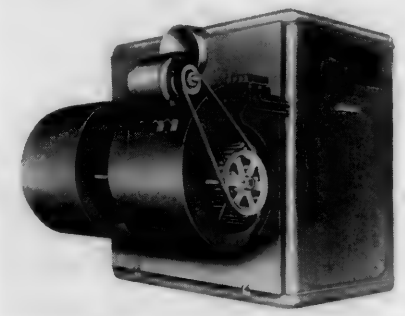
outdoor use and exposure to freezing rain and snow, the company states. Since it is unaffected by acid and alkaline atmospheres, it is well suited for use in industrial locations.

More Information? Circle Item 47 on Inquiry Card.

Improved Dual Blower Systems

Reznor Manufacturing Co., Mercer, Pa., announces the development of improved dual blower systems for its blower type gas-fired unit heaters and its modular duct furnaces.

The dual blower systems are used with the company's 250,000 Btu and 300,000 Btu US Series blower-type unit heaters, and also with the DSB Series packaged blower systems for 250,000 and 300,000 Btu modular duct furnaces.



Systems are powered by a single ½-hp motor, with the blowers mounted on a common drive shaft. Two ⅓-hp motors formerly were used to drive the blowers, which previously were mounted on individual shafts.

Utilization of a single motor not only reduces the horsepower requirement of the system, the firm reports, but also simplifies its electrical wiring and lowers operating and maintenance costs. A single drive shaft assures smooth, even inlet air flow, thus improving efficiency of the blower systems.

More Information? Circle Item 48 on Inquiry Card.

Scrub-up Sinks for Surgeons

A surgeon's scrub-up sink, offering comfort and convenience while meeting the highest sanitary standards, is announced by American-Standard Plumbing & Heating Div., New York, N. Y. Development of the new product was guided by surveys of hospital personnel.

The scrub-up sink is made of easy-to-clean, one-piece vitreous china. Its size is a convenient 28 by 22 inches, with a 5-inch-wide ledge for the fitting and for toilet or medical articles. The back height of the sink is 11 inches.

The large washing area provides surgeons with the necessary freedom of arm movement. A dip in the front rim, as well as ledge-mounted gooseneck fittings, also assure a great deal of arm clearance during the scrubbing process. The sides extend from the back shelf to the front rim of the sink to provide a baffle to prevent water from splashing around the fixture.

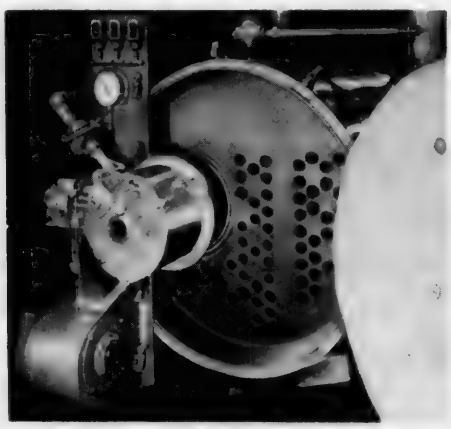
Sink is available with knee-action valve, foot-pedal valve, or with combination deck-mounted fittings.

More Information? Circle Item 49 on Inquiry Card.

Packaged Automatic Boiler Features Side-Located Furnace

Following nearly two years of research and development, Orr & Sembower, Inc., Reading, Pa., announces a packaged automatic firetube boiler possessing unusual design and offering outstanding performance.

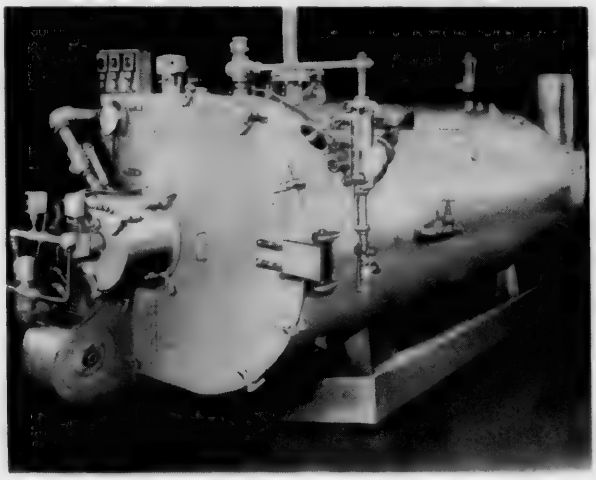
The new boiler is considerably changed in appearance from the company's previous models. Designated as Powermaster Positive Flow (Model PF), it has burner and furnace located on the left side at the horizontal center line of the boiler. It is of three-pass design with no tubes directly above or below the furnace, thus avoiding any impediment to the natural circulation flow.



According to the company, the side-located furnace was found to provide the most efficient circulation of water of any of the many designs tested. This design is said to permit boiler feed injection and natural thermal circulation to augment each other, thus providing the maximum water circulating rate and the most efficient form of heat transfer—counterflow.

The side-located furnace is reported to provide other important benefits: It eliminates danger of heat damage due to stagnant water and sludge at the bottom of the boiler. It makes all fireside and waterside surfaces easy to inspect. It permits design of turn-around spaces to be simple and accessible, with positive sealing assured.

Other features incorporated in the new boiler are: Hinged front cover, with quick-opening fasteners, can be opened for access to heating surface in less than two minutes without disturbing burner, wiring or piping. No bolts are used. See smaller photo.



Hinged front cover of packaged boiler, above, is shown swung open, at left. Cover can be opened for access to heating surface in less than two minutes without disturbing burner, wiring, or piping. Side-located furnace is said to provide most efficient circulation of water of many designs tested.

Rear cover is divided for easier accessibility and maintenance. Each cover section is hinged with quick-opening fasteners. Cover sections form a separate seal in a single plane, providing positive protection from short-circuiting of combustion gases. The design eliminates the need for internal baffles.

Back construction is available with either standard dryback or optional wetback.

Orr & Sembower plans to begin production of the new boiler in five standard sizes: 50, 60, 70, 80 and 100 boiler horsepower, all sizes available in oil-fired, gas-fired and combination-fired. Hot water and steam atomization models will also be available in all five sizes.

More Information? Circle Item 50 on Inquiry Card.

Over-Temperature Protection

Improved motor-compressor over-temperature protection, particularly for compressors that have in the past used dome-mounted controls, is reported possible with internally-mounted protectors, and motor winding thermostat-supplementary overload systems recently developed by Metals & Controls Div., Texas Instruments Incorporated, Attleboro, Mass.

Klixon hermetic protectors, sensitive to both current and temperature, can be internally mounted inside the compressor shell, adjacent to the windings, so as to follow the winding temperature closely and protect to the capacity of the motor.

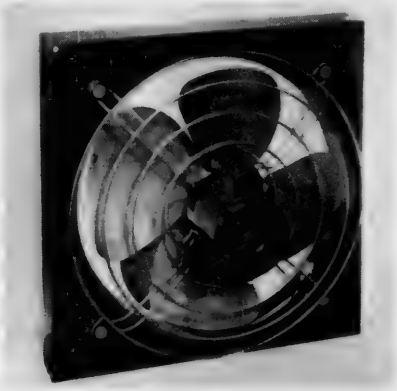
An example of what created a demand for such a device was the introduction of hermetic motors to air source heat pumps. A new range of operating conditions was introduced which complicated the degree of protection that can be provided with dome-mounted overheat protectors, the company reports.

More Information? Circle Item 51 on Inquiry Card.

Packaged Ventilating Fans

Packaged ventilating fans, designed to reduce installation, maintenance, and operating costs, have been developed for commercial, industrial, and institutional buildings by Modine Mfg. Co., Racine, Wis.

Packaged design permits easy, low-cost installation simply by placing the fan and housing in a wall opening and connecting to an electrical line. Fan guard serves as the mounting for a resilient motor and the fan itself. Complete with weather-sealed wall shutters, the fans come in seven sizes ranging from 12 to 31 inches square.



Maintenance costs are reduced because the fans are direct drive models with no fan belts to adjust or replace. Fan housings are Bonderite-treated before the baked enamel finish is applied.

More Information? Circle Item 52 on Inquiry Card.

Compact Transmitting Rotameter

The Magnarator, an instrument which combines the functions of an indicating rotameter and a pneumatic transmitter, is introduced by Fischer & Porter Co., Warminster, Pa. The instrument measures liquid or gas flows and is accurate to within 1% over its 10 to 1 range. The extensionless Magnarator complements the familiar Magnabond pneumatic transmitter, an extension type instrument, in the Fischer & Porter flow metering line.

In operation, the flow travels vertically upward through the metering tube which has no recessed or stagnant areas, and thus the device is suitable for all fluids. As the float in the metering tube is magnetically coupled to a rotating follower in the pneumatic transmitter, a positive continuous bond is assured. A dual reading, 4-inch vertical output scale indicates the flow rate and the transmitted pneumatic signal which is linear. A horizontal reading scale shows the float position independently of the air supply and the transmitter output.

The instrument is easy to install and service, and eliminates the need for offset piping, spools, tees, purges, and bleeds, the company states.

More Information? Circle Item 53 on Inquiry Card.

Plastic Drainage Fittings

Production of polyolefin-type plastic fittings for acid and other industrial drainage piping is announced by Tube Turns Plastics Inc., Louisville, Ky.

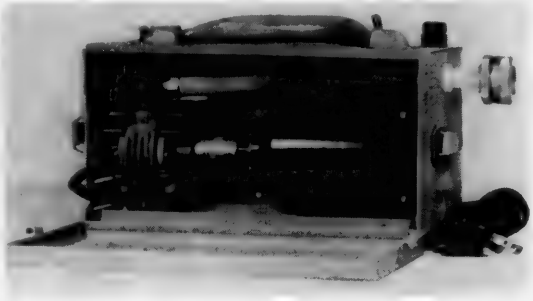
Development of the new line was prompted by the recent perfection of the Thermo-Seal method of homogeneous fusing that has eliminated past difficulties in joining polyolefin pipe components, the company adds.

The firm will stock Schedule 40 polyethylene pipe and drainage fittings in 1½-inch through 4-inch sizes, with larger sizes available on order. Fittings include a complete selection of bends, wyes, tees and traps.

More Information? Circle Item 54 on Inquiry Card.

Multi-Purpose Air Sampler

An air sampler for both continuous duty and survey air sampling, developed by Gelman Instrument Co., Chelsea, Mich., draws up to 16 liters per min of air through a filter paper. Unit consists of vacuum pump, flowmeter and filter holder built into a protective carrying case. Dimensions: 9 x 5 x 4.5 inches. Net weight: 8 lb. The sampler operates on 110 volt 60 cycles with other voltages available.



Filter holder is quickly connected or disconnected to sampler by plastic fitting. This makes it possible to load filter holders in the laboratory and then make changes in the field in order to avoid contamination.

Sampler can be used for a variety of other dust sampling work: to monitor "white" rooms, for checking air cleaning systems, for checking efficiency levels, and losses of valuable chemicals and for checking air borne pathogens.

More Information? Circle Item 55 on Inquiry Card.

(Continued on page 153)

McQuay

air-conditioning equipment

Including the New Single and Multi-Zone Air Handling

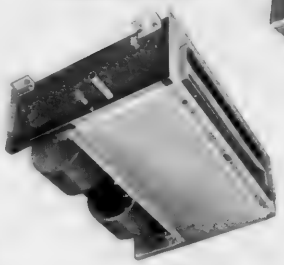
McQuay Means Quality

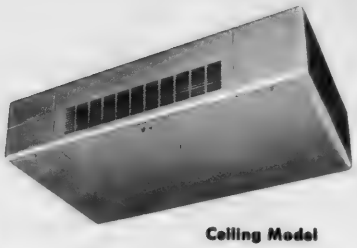
McQuay

SEASONMAKERS

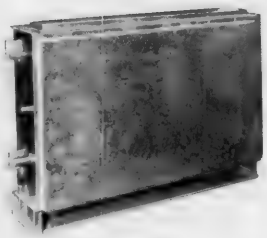
McQuay offers the finest in remote type, individual room air conditioners for use with a central station heating and cooling system. Extremely quiet, the "Seasonmaker" is available in floor, basic, ceiling and hideaway models in a wide range of sizes to meet your exact requirements. Floor and basic models range from 220 to 1240 cfm, and ceiling and hideaway models range from 220 to 640 cfm. Write for catalog 715.

Hideaway Model



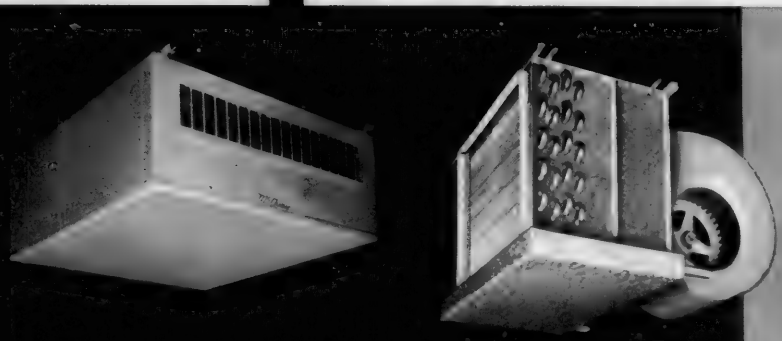


Ceiling Model



Basic Model

Floor Model



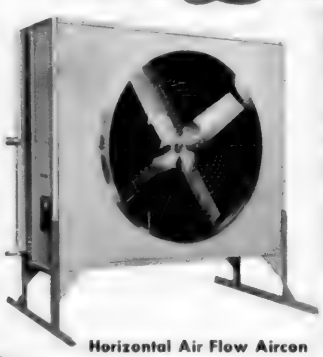
LARGE CAPACITY SEASONMAKERS

5 TO 10 TONS CAPACITY

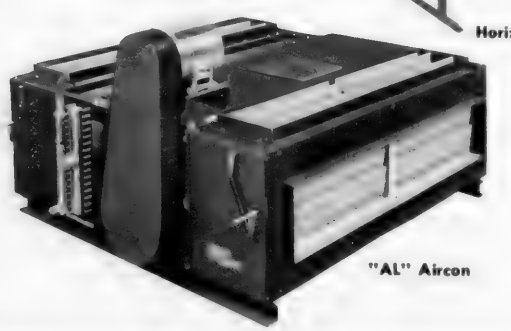
Remote type ceiling suspended air conditioners for medium to large areas. Designed for fully recessed closet and false ceiling installations, or horizontally suspended in the conditioned space. The quiet, attractively styled McQuay large capacity "Seasonmaker" is available in four sizes of direct drive and five belt driven models. Write for catalogs 722 and 730.

McQuay

Vertical Air Flow Aircon



Horizontal Air Flow Aircon



"AL" Aircon

REMOTE TYPE AIR COOLED CONDENSERS

"AB" AIRCONS—Propeller fan types available in either horizontal or vertical air flow. Thirteen sizes each from 8 to 85 tons nominal capacity. Multiple installations make capacity unlimited. Write for catalog 629.

"AL" AIRCONS—Centrifugal fan types are designed for outdoor or indoor installations with or without duct work. They may also be used for exhaust ventilation and heating. Compactly engineered with a low silhouette, there is a wide range of unit and fan discharge arrangements. Write for catalog 635.

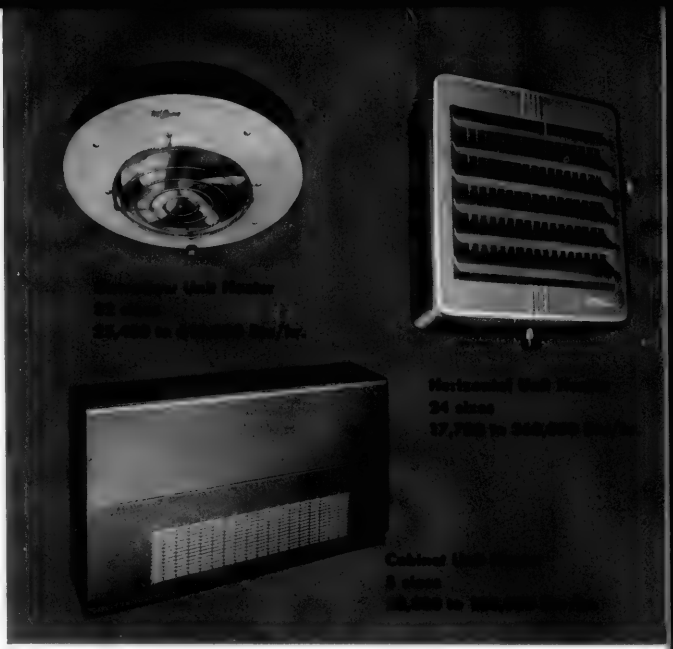
AUTOMATIC HEAD PRESSURE CONTROL

The McQuay type "AB" and "AL" Aircons are available with air side and refrigerant side head pressure control. The "AB" line is offered with opposed blade face dampers and corresponding controls for automatic operation.

McQuay

UNIT HEATERS

Horizontal, downflow and cabinet type unit heaters are available in an exceptionally wide range of sizes and capacities for either steam or hot water. Adjustable louvers and several varied styles of air deflectors are available. McQuay cabinet type unit heaters are available for floor, wall and ceiling applications; for exposed, semi-recessed or fully recessed installations. Write for horizontal unit heater catalog 323, downflow unit heater catalog 765, cabinet unit heater catalog 351.



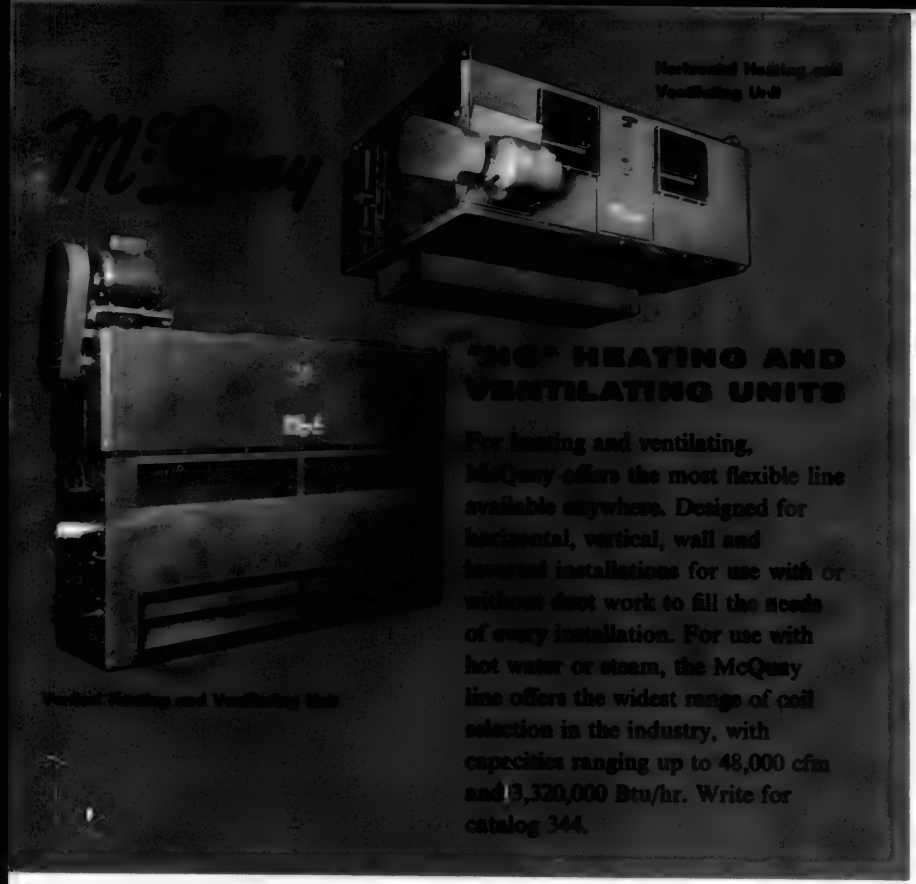
McQuay

SEASONMASTERS

SINGLE AND MULTI-ZONE CENTRAL STATION AIR CONDITIONING UNITS

McQuay proudly offers a completely new line of quality engineered central station air conditioning units. A new space saving design, available in both single zone draw through and multi-zone or double duct blow through arrangements in low pressure (up to 3″ s.p.) and medium pressure (3″ to 5½″ s.p.), makes the McQuay line the most complete and versatile throughout the industry. Twenty-four models with multiple coil sizes insure the proper fan and coil combinations for every requirement. A full line of accessories is available. Write for catalog 560.

Vertical Seasonmaster



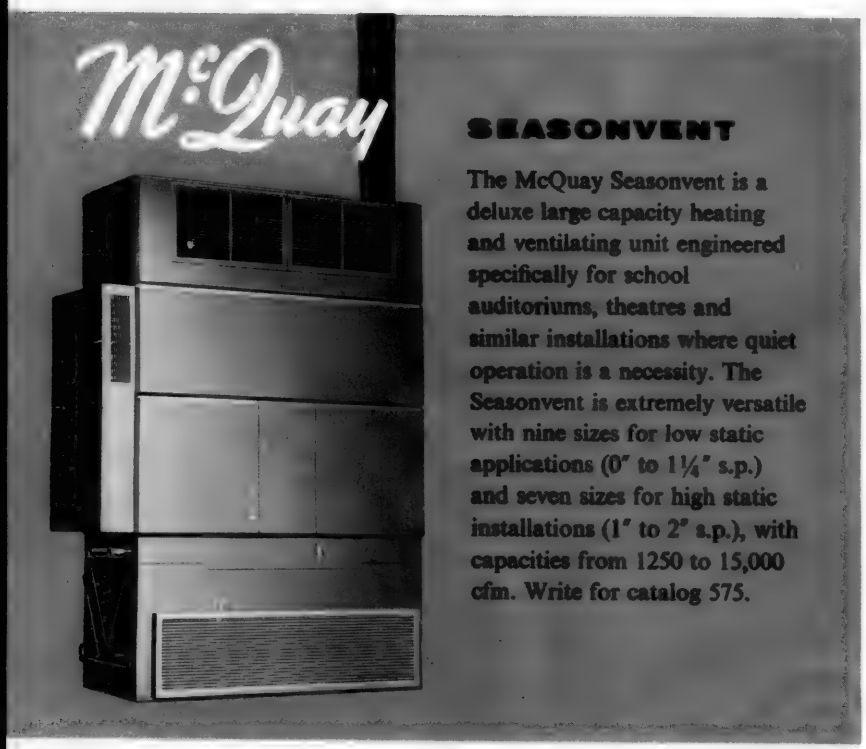
"HC" HEATING AND VENTILATING UNITS

For heating and ventilating, McQuay offers the most flexible line available anywhere. Designed for horizontal, vertical, wall and recessed installations for use with or without duct work to fill the needs of every installation. For use with hot water or steam, the McQuay line offers the widest range of coil selection in the industry, with capacities ranging up to 48,000 cfm and 3,320,000 Btu/hr. Write for catalog 344.

RIPPLE-FIN COILS

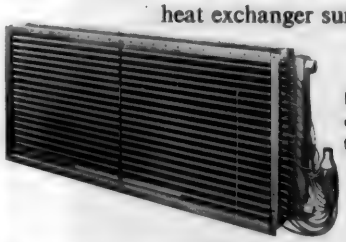
By the Nation's Largest Coil Manufacturer

A new type "5" coil design with a wide range of available fin spacings offers unlimited selection to meet all load requirements. This new design affords a new high in fin efficiency by attaining the highest heat transfer rate possible without excessive air friction. The combination of equilaterally staggered tubes and modified rippled fins produces maximum air turbulence, and intimate and prolonged contact between air and heat exchanger surface.



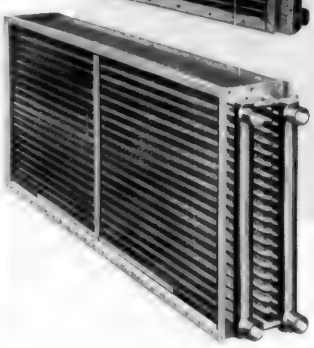
SEASONVENT

The McQuay Seasonvent is a deluxe large capacity heating and ventilating unit engineered specifically for school auditoriums, theatres and similar installations where quiet operation is a necessity. The Seasonvent is extremely versatile with nine sizes for low static applications (0″ to 1¼″ s.p.) and seven sizes for high static installations (1″ to 2″ s.p.), with capacities from 1250 to 15,000 cfm. Write for catalog 575.



Direct expansion coils with pressure type distributors.

Pitched in casing steam coils. Easy installation and positive condensate draining.



Flow circuited water cooling and heating coils.

McQUAY, INC., 1600 Broadway N.E., Minneapolis 13, Minnesota

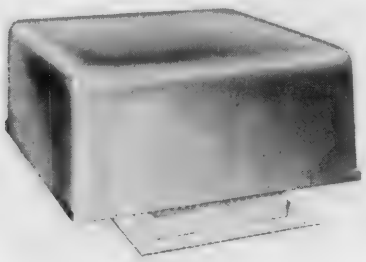
McQUAY INC.

AIR CONDITIONING • HEATING • REFRIGERATION

DM—1961-2 Printed in U.S.A.

Glass-Fiber Housings in Color

In order to provide new "eye appeal" for roof-top exhaust fans, Davidson Fan Co., Newton, Mass., announces glass-fiber housings in color for its Hyduty roof exhaust fans.

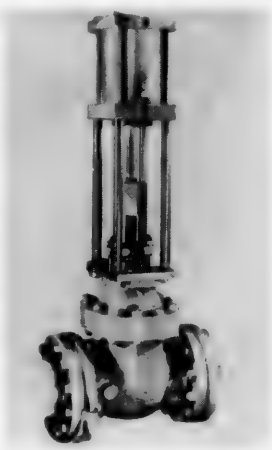


Housings are available in six colors: dark blue, light blue, tangerine, buff, gray and white. Color is sealed in, and housings require no maintenance. Glass fiber housings withstand heat, cold, moisture and fumes, and also act as sound deadener.

More Information? Circle Item 56 on Inquiry Card.

Universal Cylinder Operator

Development of a universal cylinder operator adaptable to OS&Y, iron body, wedge or double-disc gate valves, is announced by Industrial Products Group, Crane Co., Chicago, Ill. Factory installed valves with cylinder are available, but cylinder may be had in kit form for field installation on Crane iron body hand-operated valves, which installation takes about 30 minutes.



Valves are actuated by a double-acting cylinder, using water, air, or oil as the operating medium. The cylinders are controlled by operation of a four-way valve, which may be located in any convenient place within a reasonable distance from the main valve. Fixed orifices in the cylinder ports maintain an operating speed of one inch per second, minimizing slamming and sticking. No cushions or speed controls are necessary.

Seals are the "pressure sealing" type and meet Joint Industry Conference standards. Tube and seals are of Teflon, which is immune to damaging effects of all hydraulic fluids, air, water, and gases. A piston rod stem coupling provides visual indication of the valve disc position, and can also be used for emergency manual opening or closing of the valve, eliminating any need for a tail rod.

According to the company, the 127 valve-cylinder combinations available will meet thousands of different operating conditions.

More Information? Circle Item 57 on Inquiry Card.

17-Ton Evaporator

Extraordinary flexibility is the boast of a new 17-ton blower-powered evaporator unit offered by Lennox Industries, Inc., Marshalltown, Iowa. With evaporator coil and filter section remaining fixed in a horizontal arrangement, variations in blower location and direction of air flow provide for upflow, downflow or horizontal air delivery. Furthermore, the blower section can be mounted horizontally at the end of the section containing the evaporator and filter or on top for vertical upflow or left or right hand horizontal air delivery.

Evaporator coil (as illustrated) is constructed of durable ripple-edged aluminum fins that are flat-bonded to seamless copper tubes. It is easily removed from the cabinet and may be turned end for end permitting refrigeration line connection at either end of cabinet.

All interior plumbing is factory installed complete with distributors, manifolds and expansion valves. The field plumbing connections are stubbed to the outside of the cabinet. The 2-inch deep condensate pan is coated on both sides with corrosion-proof material and has a threaded drain connection.

Blower section consists of twin 15-inch blowers on a single shaft and powered by whatever motor and drives are needed for the cfm and static requirement of a specific installation. The shaft operates in flange-mounted ball bearings permitting multi-position mounting of the blower section and positive vertical alignment of the bearings.

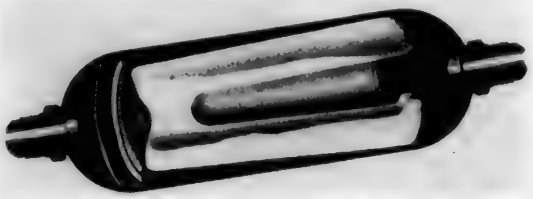
Filter section connects to either the blower or coil secion air intake and access doors are provided at both ends. Filter tracks will accept 2-inch standard size throwaway type filters and 1-inch spacers are provided so that 1-inch thick filters may be used if desired.

All three cabinets are completely weatherproof. Heavy gauge galvanized steel is finished in thermo-setting acrylic enamel. Blower and coil cabinets are lined with 1½-inch lb density Fiberglas insulation.

More Information? Circle Item 58 on Inquiry Card.

Refrigeration Drier

A refrigeration drier is available in sizes from one through 15 tons from Kenmore Machine Products, Inc., Lyons, N. Y. By eliminating plastics, fibre board, cotton and other foreign materials from the inside of the drier and by using a solid core of 100% Molecular



Sieves without diluents, the KMP Filter-Kore drier gives maximum protection to the system from acid and sludge after motor burn-out, the company states.

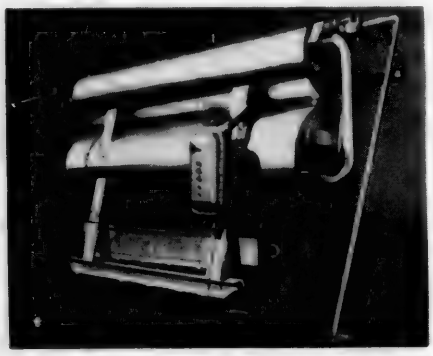
Drier is said to deliver fine, selective filtration without powdering or channelling of refrigerant through the core.

More Information? Circle Item 59 on Inquiry Card.

New Gas Absorption Chiller

Statham Instruments, Inc., Los Angeles, Calif., announces production of a gas absorption cooler for commercial and industrial applications, said to result in operating cost saving from 35% to 50% over existing conventional cooling units. A two-effect generator is applied to a lithium bromide-water absorption cycle.

In the application of the two-effect generator principle of operation, heat is applied to a spent solution of lithium bromide in the *first effect* generator. The solution boils, liberating water vapor, and produces a more concentrated solution. The concentrated lithium bromide then passes through a coil which serves as a



second effect generator. The pressure in the second effect generator is lower than that of the first effect generator. Because of this reduced pressure, the solution boils at a lower temperature than that of the condensing vapor from the first effect generaor. Thus, this second coil is heated by the condensing vapor from the first distillation step, *and this saves the additional fuel which would otherwise be required and is the basis for the high efficiency of the cycle.* As a result the solution is brought to full concentration. The vapor from the second effect generator is condensed on a water-cooled condenser coil.

The fully concentrated lithium bromide solution then acts as the absorbent for the refrigerant vapor. The combined condensate from both the first and second effect generators is delivered to the evaporator. The resultant refrigerant is then pumped over the chiller coil where it cools the coil by evaporation. The resulting vapor from evaporation is absorbed into the concentrated lithium bromide solution.

The dilute lithium bromide solution that is formed is pumped to the first effect generator and the cycle is repeated.

According to the manufacturer, in this process there is one Btu removed from the chiller for each Btu of heat supplied to the unit, and this now makes cooling as cheap as heating.

More Information? Circle Item 60 on Inquiry Card.

Room Humidifier

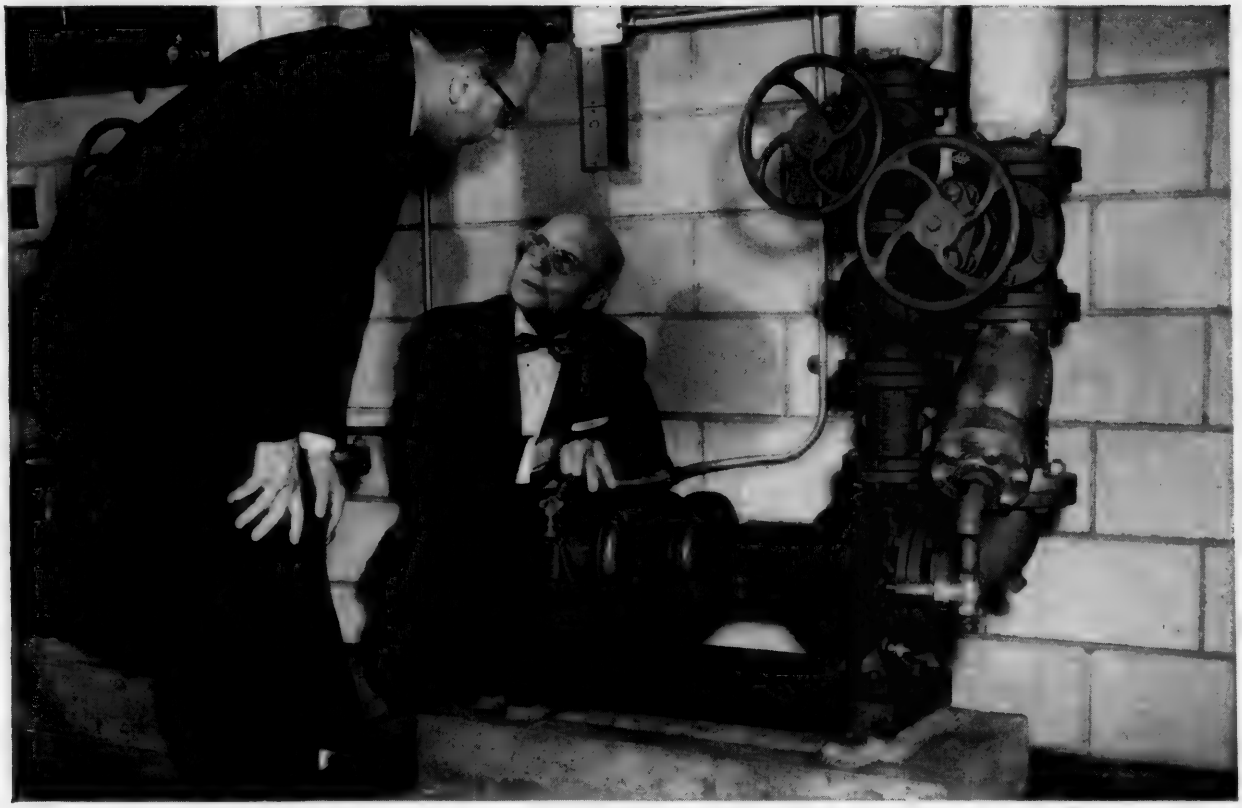
A portable and commercial humidifier is offered by Rotherm Engineering Co., Inc., Chicago, Ill. It is a combination of water container with an electrical heating element suspended above the water. A spinner attached to an electrical motor lifts the water from he container and sprays it against the heating element, effecting vaporization.

Steam is not visible, the company points out, when introduced into a room at approximately room temperature, so that there is no condensation. Vapor produced is approximately 85-90% rh at about 5 deg F above room temperature.

A fan attached to the motor draws circulating air over the heating element and forces the vapor into the room. A float control switch responds to water level in the container, shuts off heating element current at low level.

Units are available for commercial applications which can be furnished with automatic float and water level control valve and with ceiling hanger.

More Information? Circle Item 61 on Inquiry Card.



"SURE IT'S RUNNING! YOU CAN TELL IF YOU TOUCH IT!"

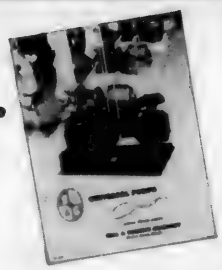
B&G UNIVERSAL PUMPS ARE NOW AVAILABLE IN SIZES TO 75 H.P.

B&G Universal Pumps for larger forced hot water systems are extra quiet, extra smooth in operation. They are designed and built specifically for one job—to satisfy the exacting demands of circulated water systems...no special vibration eliminators or flexible connections to the piping are needed.

Motors are built and selected for *quiet* operation; long *sleeve* bearings are used in both motor and pump, and the oversized shaft is special alloy steel with an integral, heat-treated thrust collar. Water leakage is prevented by the exclusive diamond-hard "Remite®" mechanical seal. Flanges, bolts, nuts and gaskets for both suction and discharge sides, pet cocks for venting and gauge tappings are furnished without extra charge.

Now added to their numerous design advantages is an increase in sizes to 75 HP, 2000 GPM, 170 ft., 1750 RPM, 3″—4″—6″—8″ discharge connections. Every conceivable circulation requirement of systems using water for heating and cooling can be satisfied within the wide capacity range of B&G Universal Pumps.

Send for descriptive literature and engineering data



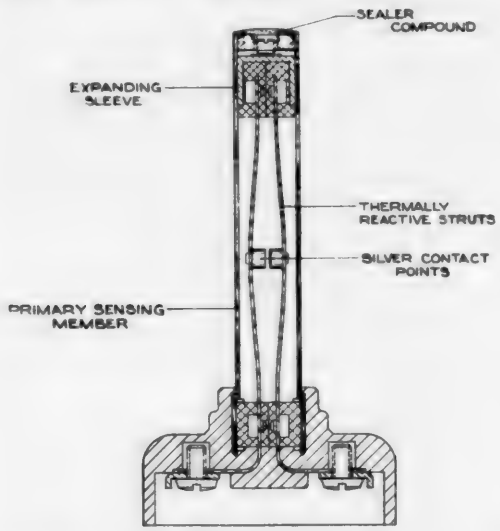
BELL & GOSSETT
COMPANY
Dept. GN-4, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ontario

For more data circle this page number on card at back of book

Fire Detection Thermostat

Thermotec Model 302 thermostat, said to increase the efficiency of any fire detection installation, is offered by Tomorrow, Inc., Hayward, Calif.

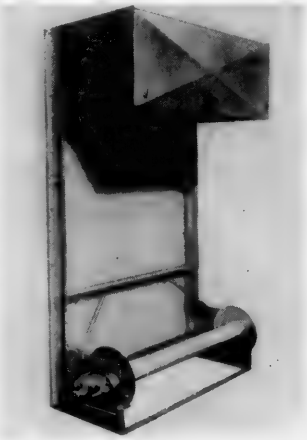


According to the manufacturer, the unit is able to sort out normal temperature changes from actual fire conditions with a precision heretofore considered impossible. It is used as a replacement element in present systems in addition to its use in new systems.

More Information? Circle Item 66 on Inquiry Card.

Roll-Type Air Filter

Production of V-7 Roll-Kleen air filters, which operate on the same principle as the film roll in a box-type camera, is announced by Farr Co., Los Angeles, Calif. The filtering media which comes in a roll, unwinds from the top. It passes downward across the face of the air cleaner and as media is used, it is rewound on a bottom spool. Used filter rolls are disposable.



When pressure drop reaches the pre-set limit, a pressure switch actuates the mechanism that advances the media, presenting a clean media surface to the air stream at all times. Models with either automatic or manual drive are offered.

Media roll is a glass filter material 65 ft in length, said to have a high dust-holding capacity with an efficiency above 81%, operating best between 350 and 500 fpm. Except for media change, only periodic inspection and lubrication are required.

More Information? Circle Item 68 on Inquiry Card.

Overhead Infra-red Gas Heater

An overhead infra-red gas heater is offered by Space-Ray Corp., Charlotte, N. C., for high ceiling industrial and commercial buildings of any size. Units operate on either natural or LP gas and come with self-energizing thermostat for automatic operation.

Heat of the heater is its cone-shaped, stainless steel, infra-red heat emitter. A large reflector focuses heat rays downward to warm floors, men, machinery and tools, without the necessity of warming all the air in the building. Cast iron multi-port burner is unconditionally guaranteed for a lifetime of trouble-free service, the company states. Height of unit is 16 inches; diameter, 33 inches; weight, 33 lbs.

More Information? Circle Item 67 on Inquiry Card.

Copying Machines

Two portable copying machines, available from Jimco, Watervliet, Mich., are said to be well suited to requirements of drafting rooms where blue-line-on-white copies of sketches or of other one-side-only originals are needed.

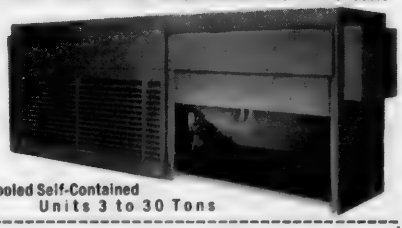
A small model, The Commodore, reproduces copies up to 10 x 13 inches. A larger model, The Ambassador, has a capacity for copying material up to 18 x 24 inches. According to the distributors, sketches, line drawings, and printed material are reproduced with extreme clarity.

Each model has two parts. An exposure unit, with automatic timer, produces copies in about 45 seconds from any translucent paper. Two minutes of exposure time may be required from regular stationery. Timer shuts off automatically after copy is made. A developing chamber produces permanent copies on any ammonia-sensitive paper. No day-to-day care or maintenance is required.

Units are low in first cost and will make copies for approximately one to four cents apiece, depending upon sheet size, the company states.

More Information? Circle Item 69 on Inquiry Card.

The confident gentleman. He knows Typhoon units are loaded with features that assure satisfaction. As for the other gentleman, he'll know better next time—if there is a next time. With the addition of 28 new units to its 1961 line, Typhoon offers the industry's broadest, biggest, most versatile group of packaged air conditioners, furnaces and heat pumps. Typhoon economy begins with its mass produced components, which can be custom-assembled to your order to meet any unusual requirement... **at little or no extra cost.** Typhoon quality begins with Power Reserve—superior components and oversize parts to deliver beyond rated capacities. Each Typhoon unit is built to take extreme weather conditions and sudden severe temperature changes without strain or breakdown. The 28 new units include nine heat pumps, three air handlers, three air cooled remote condensing units, three air cooled condensers, and ten self-contained package units. **For complete satisfaction,** specify Typhoon. It suits every need in air or water cooled units; ceiling, floor or roof mounted units; units that heat and cool or cool only—in capacities from 3 to 75 tons. Write today for complete product literature.



Air Cooled Self-Contained
Units 3 to 30 Tons

TYPHOON
HUPP

TYPHOON AIR CONDITIONING DIVISION, HUPP CORPORATION 2-2-1
505 Carroll Street, Brooklyn 15, New York

☐ Please send me full product literature on Typhoon's 1961 Line.
☐ Please have a representative call for an appointment.

NAME_____

FIRM_____

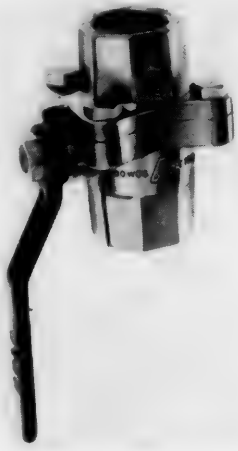
ADDRESS_____

CITY_____ ZONE_____ STATE_____

For more data circle this page number on card at back of book

New Type Ball Valve

A new ball valve design is incorporated in its Fig. BL-300 forged naval bronze valve introduced by R-P&C Valve Div., American Chain & Cable Co., Inc., Reading, Pa.



Rated at 300 lb for water, oil or gas service at a maximum temperature of 250 deg F, and available in sizes ½ to 2 inches inclusive, valve is fast and easy to operate, since it requires only a quick quarter turn of the handle to open or close compared to several full turns needed to operate a gate or globe valve, the company states. In addition, this precision-built valve for general purpose is said to be offered at a cost no more than a high quality standard bronze gate valve.

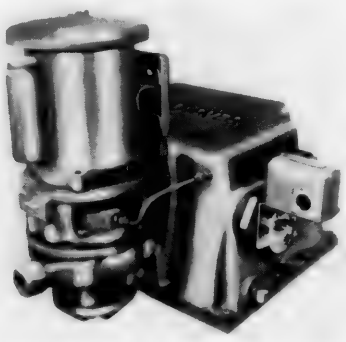
"Auto-mating" seats assure positive sealing in either flow direction, which makes it well suited to vacuum service. Wiping action of the ball across the seats forces out foreign matter and thus prevents abrasive wear which would cause leakage.

More Information? Circle Item 74 on Inquiry Card.

Condensation Return Unit

Syst-A-Matic, a compact condensation return unit for the heating and air conditioning field has been designed by Carver Pump Co., Muscatine, Iowa.

Unit has been engineered for both 1750- and 3500-rpm, and requires a minimum of floor space and a low return (9 inches above floor). Heavy cast bronze impellers designed for hot water are cleaned and balanced for smooth operation. Heavy cast iron pump casings, receiver and stainless steel pump shaft insure long trouble-free operation.



Pump is available with packing or mechanical seal. Mechanical seal has stainless steel rotating parts with a carbon ring and ceramic stationary seat. Seal chamber is fitted with automatic relief line to prevent vapor locking. Heavy-duty float switch of two-pole type, is installed, adjusted and tested at factory Pump assembly may be removed without disturbing inlet and discharge piping.

More Information? Circle Item 75 on Inquiry Card.

Fans Require Less Power

A series of airfoil centrifugal fans called Design 10, for air supply and exhaust in air conditioning, ventilating, industrial processing or mechanical draft applications, is introduced by Chicago Blower Corp., Franklin Park, Ill. Prime performance features over the original Chicago design are slower speed and lower noise levels. This new design catalogs static pressures of ¼ to 30 inches in volumes ranging from 440 cfm to 560,000 cfm and temperatures up to 800 deg F.

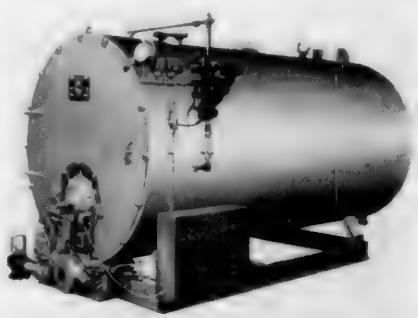
Fans are engineered to operate at low horsepower requirements, permitting the use of smaller motors and thus reducing power consumption. Hollow airfoil shaped blades provide 20% to 40% quieter operation, and increase operating efficiencies, the company states. Sizes 12¼ to 89 and five construction classes are offered.

More Information? Circle Item 76 on Inquiry Card.

3-Pass Packaged Boiler

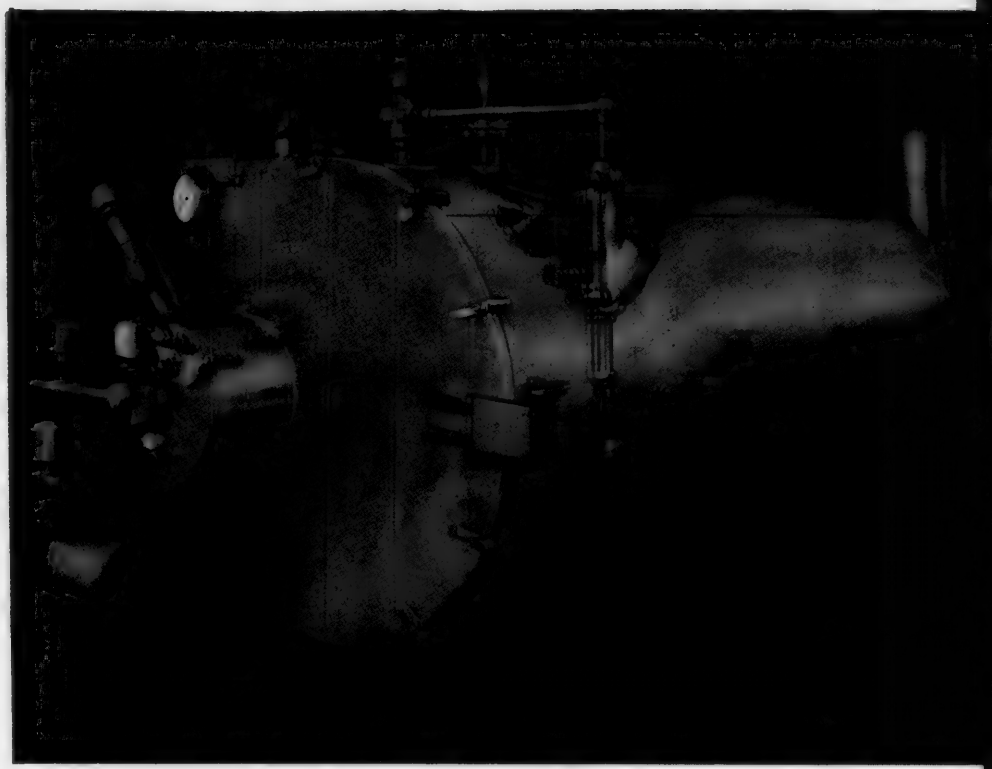
Ray Burner Co., San Francisco, Calif., announces a new 3-pass packaged boiler with capacities from 30 to 300 hp. These fully automatic units are available to fire gas, all grades of fuel oil, or combination gas-oil.

The company's Viscomatic controlled air atomized



firing, with its Viscosity Valve control system and dual pump and reservoir, assure constant fuel delivery regardless of oil temperature or viscosity. Enclosed control cabinet contains complete pre-wired operating and programming type flame safeguard controls and circuit breakers.

More Information? Circle Item 77 on Inquiry Card.



Introducing the *Powermaster*® Positive Flow® Boiler

...the greatest advance in packaged firetube boiler design in seven decades!

Here for the first time, is a packaged boiler that gives you an ease of operation, dependability and accessibility often hoped for but never before achieved!

The result of more than two years of development and testing, the *Powermaster Positive Flow* boiler has been tried, tested and proved by one of America's foremost consulting engineer firms. Among its many tried and proven features are: accelerated internal circulation which greatly improves heat absorption efficiency . . . *PyroFlow*® burner system which can be easily converted in the field from/to either oil or gas without burner modification . . . hinged front and rear covers . . . optional dryback or wetback construction . . . quieter operation.

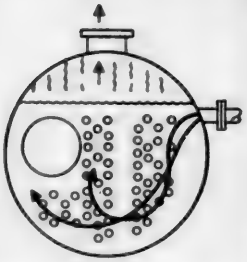
No other boiler can match the performance of the Powermaster Model PF for generating steam or hot water economically and dependably. A comparison of performance tests with other boilers will prove this is no idle statement.

See a demonstration of this highly advanced boiler at the International Heating & Ventilating Exposition in Chicago, Feb. 13-16, Booth 207, or write for Bulletin No. 1275. A leasing arrangement may be made with your local O&S distributor.

ORR & SEMBOWER, INC.
BUILDERS OF BETTER BOILERS SINCE 1885

ORR & SEMBOWER, INC.
980 Morgantown Road
Reading, Pa. • Since 1885

Powermaster®
POSITIVE FLOW®
PACKAGED AUTOMATIC BOILERS

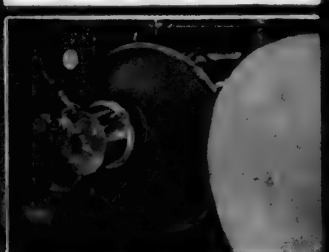


POSITIVE CIRCULATION

Design permits boiler feed injection and natural thermal circulation to augment each other. This provides the maximum water circulating rate and the most efficient form of heat transfer, **counterflow.**

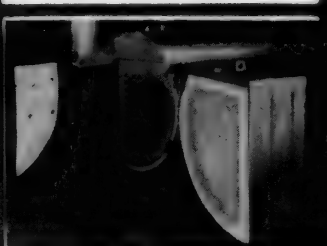
SIDE LOCATED FURNACE

Side located furnace eliminates danger of heat damage due to stagnant water and sludge. Turn-around spaces are simple, accessible and positive sealed.



HINGED FRONT COVER

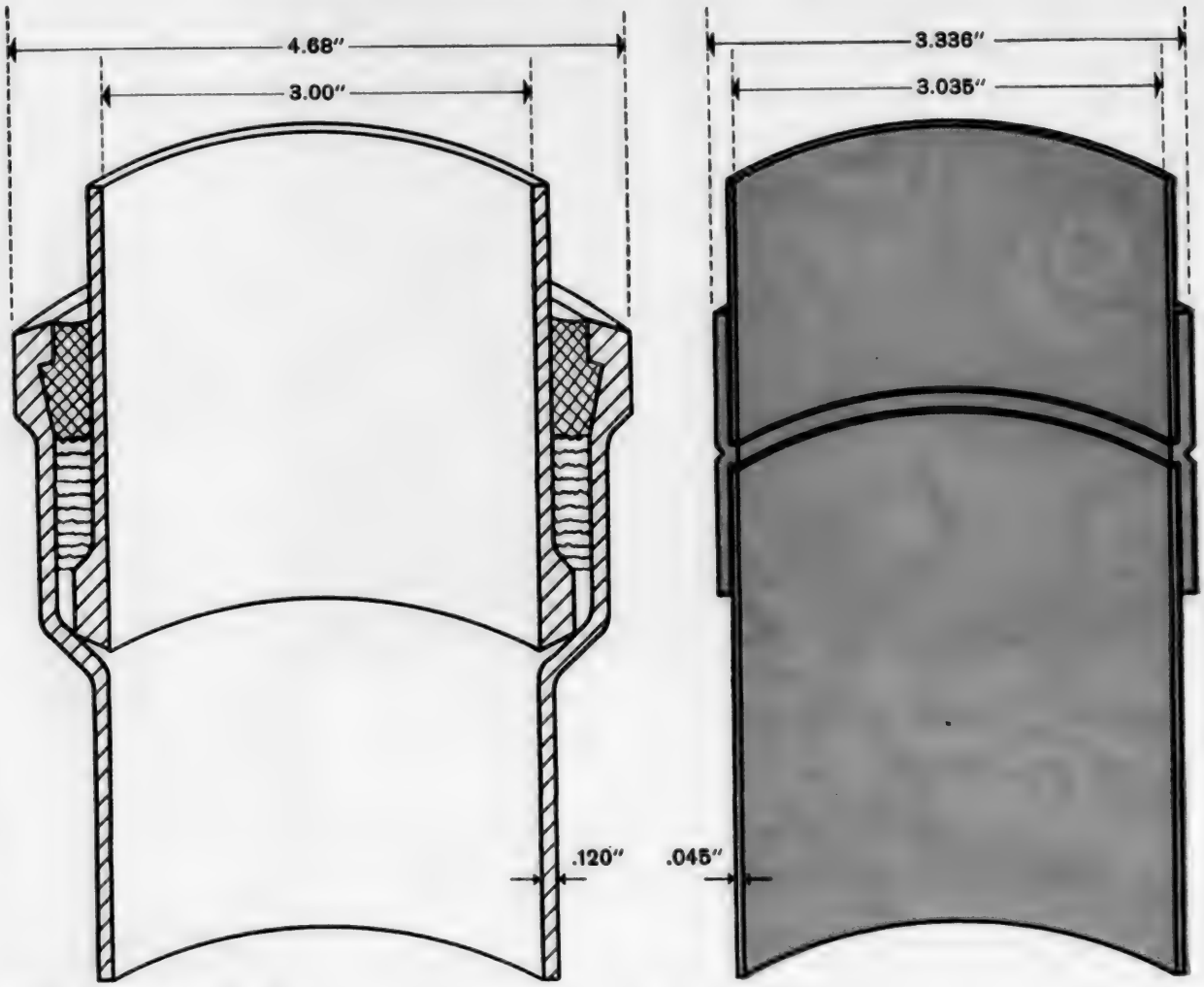
Hinged front cover, with quick-opening fasteners (no bolts) can be opened for access to heating surface without disturbing burner, wiring or piping.



DIVIDED REAR COVER

Hinged rear cover, also with quick-opening fasteners, permits ease of accessibility and maintenance. Each cover section forms a separate seal in a single plane, providing protection from short-circuiting of combustion gases. No internal baffles to leak.

IT JUST DOESN'T MAKE SENSE!



Take a good look at this dimensional comparison of service-weight cast iron drainage pipe and Type DWV copper tube. You'll see why it makes good sense to use Anaconda Copper Drainage Tube Type DWV, and Anaconda Solder-joint Fittings for soil, waste and vent lines. You can do a better job, easier, faster and at less cost. **BETTER,** because rust-caused troubles such as reduced flow or stoppages just don't occur in copper plumbing. Also, the builder is saved the extra cost of wide plumbing walls—a 3" copper tube stack fits within a partition of standard 2 x 4's—whereas, in ferrous piping, a 4" cast iron soil stack is generally used, requiring 2 x 6" studs. **AT LESS COST** because installation time is cut one-third to one-half, and here's why. Longer copper tube lengths mean fewer joints, and the lighter weight (about ¼ the weight of a ferrous pipe installation) permits cost-saving assemblies of rough-in units in the shop. Solder-joint fittings are connected quickly. Take a look at a plumbing contractor's estimated cost comparison for a typical, back-to-back bathroom—kitchen—laundry drainage system.

USING COPPER

Anaconda Copper Drainage Tube, Type DWV* (*93 ft. of various sizes*)	$ 72.74
Anaconda Cast Brass Solder-joint Fittings	67.97
Solder, Flux, Sand Cloth	2.00
Materials cost	$142.71
12 Hours Labor	60.00
Installed cost	$202.71

*Copper tube marked DWV (*Drainage, Waste, Vent*) identifies tube used only for sanitary drainage lines.

USING FERROUS PIPE AND FITTINGS

Cast Iron and Steel Pipe (*93 ft. of various sizes*)	$ 60.71
Fittings	58.10
Caulking, Lead and Oakum	21.88
Materials cost	$140.69
22 Hours Labor	110.00
Installed cost	$250.69

Anaconda American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario. 6101

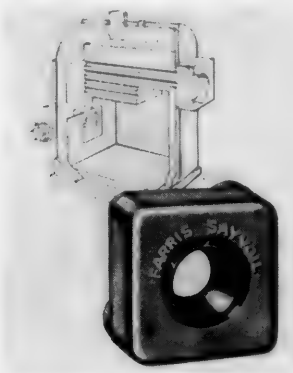
ANACONDA® **COPPER TUBE AND FITTINGS for soil, waste and vent lines**

Available through plumbing wholesalers. Anaconda American Brass Company.

For more data circle this page number on card at back of book

Burner-Mounted Fuel Economizer

A new burner-mounted fuel economizer, reported to reduce fuel oil costs up to 25% and practically eliminate smoke, is available from Farris Combustion Controls Corp., Palisades Park, N.J.



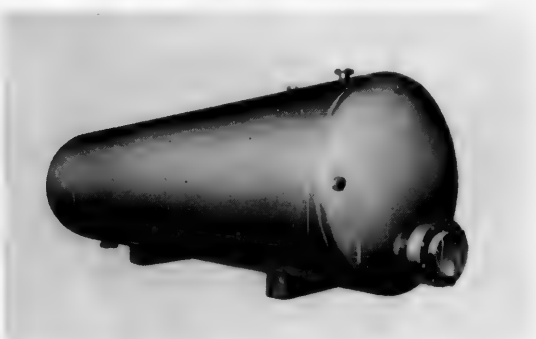
The low cost unit, known as the Sayvoil, injects an envelope of preheated air (up to 875 deg F) around atomized oil burner flame to produce more rapid combustion and more complete burning of fuel.

Without the Sayvoil, boiler intake air enters burner unheated, limiting combustion efficiency and causing smoke, soot and carbon deposits. With the unit, preheated intake air burns fuel more completely without waste. Required temperature is reached faster and maintained with less fuel, the company reports. Smoke is reduced as much as 90% or completely eliminated. The unit is also described as a practical and economical means of limiting air pollution.

More Information? Circle Item 70 on Inquiry Card.

Storage Water Heaters

Niagara Weldments Inc. (formerly Niagara Welding & Boiler Works, Inc.), Niagara Falls, N. Y., introduces a line of fully standardized storage water heaters under the trade name "Niawel."



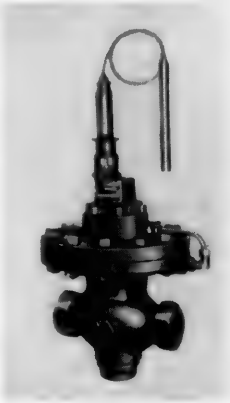
The line includes 55 sizes in both vertical and horizontal models, plus a choice of 114 heating elements, all conforming to ASME specifications throughout. Tanks are of welded steel construction. Removable, U-tube heating elements are constructed of seamless drawn Admiralty or copper tubing.

To extend tank life and effectively combat corrosion, NiaWel tanks can also be fabricated from copper-silicon, Monel, Inconel, aluminum, nickel-clad or stainless-clad steel. In addition, standard steel tanks can be supplied with various linings and coatings, such as phenolic, porcelain, cement, or hot dip galvanizing.

More Information? Circle Item 71 on Inquiry Card.

Temperature Regulators

A line of temperature regulators for storage type heating and cooling applications is announced by Leslie Co., Lyndhurst, N. J. Called the Leslie-Eventemp, units are said to meet the growing commercial, industrial and marine need for a regulator that will "full stroke" the valve with a smaller temperature change than for vapor pressure or gas filled type regulators used in most storage type heating and cooling.



Regulators are single seated, self-contained units, diaphragm actuated, with lever-type internal pilot. With only two moving parts in the regulator body, no close-fitting parts to clog, bind or seize, units are said to be accurate and dependable. Also, pressurized, friction-free Teflon stem seal and positive seating main valve are said to eliminate the common troubles with this type of unit.

Cast iron and bronze bodies are offered in sizes from ½ to 4 inches, with inlet pressures to 175 psi, temperatures to 500 deg F.

More Information? Circle Item 72 on Inquiry Card.

Gas Water Heaters

Republic Appliance Div., Republic-Transcon Industries, Inc., Beverly Hills, Calif., introduces a line of gas water heaters with a new Super Silent Economizer gas burner.

Besides being very quiet, the burner is more efficient, more strongly constructed, and more securely mounted, the company states. It can easily and quickly be converted to use either natural or liquefied petroleum gases. When operating on propane gas it gives a Btu input equal to that of natural gas.

Pilot light on the burner has also been improved, particularly by the provision of an air filter that positively prevents the flame from being put out by accumulations of dust or lint.

More Information? Circle Item 73 on Inquiry Card.

Oil-Less Motor Compressor

A miniature 1/12-hp oil-less motor-powered compressor and vacuum pump said to deliver more free air than any rotary, diaphragm or piston design unit of the same horsepower is available from Bell & Gossett Co., Morton Grove, Ill.

Because of its small size (5 inches wide, 8⅛ inches high, 8¾ inches long) and its quiet operation requiring no lubrication maintenance, the miniature unit is especially suited to a wide range of industrial, laboratory and office uses: for medical equipment, office machines, display equipment, aeration of liquids, laboratory equipment, atomizing liquids, air brush work, printing equipment, labeling machines, air sampling, small industrial machinery, mist coolant work, agitation and liquid transfer operations, and test equipment.

Two models are available: Model LV, which has a 1.9-cfm displacement and is capable of continuous operation up to 27 inches of vacuum, and Model LC, which has a 1.43-cfm displacement and is capable of continuous operation up to a pressure of 65 psig.

More Information? Circle Item 86 on Inquiry Card.

Gas-Fired Duct Heater

A gas-fired heater for duct installations with a central air supply is developed by Bryant Mfg. Co., Indianapolis, Ind. The Model 330 heater boasts a tri-alloy heat exchanger with each tube fired individually; also minimum air resistance in combination heating-cooling applications. Models are available in eight sizes from 50,000 to 250,000 Btu per hr. Matching blower packages are also available.

The company stresses the flexibility of the unit, with its reversible gas manifold and draft diverter. The cast iron, drilled port burners can be easily serviced from the rear with no bottom access space required. Controls are low in voltage for comfort and safety.

More Information? Circle Item 87 on Inquiry Card.

(Continued on page 164)

CHECK THESE FEATURES

- ✓ Stops pulsating and chattering
- ✓ Increases heating efficiency and ouptut
- ✓ One unit handles furnace or boiler, incinerator and hot water heater on single chimney
- ✓ Keeps furnaces, boilers and chimneys free of soot
- ✓ Stops blow-back of poisonous fumes
- ✓ Ideal for homes with outside chimneys
- ✓ Fireplace units with special fittings for direct installation into chimneys with single or two-speed motors available

Will operate with temperatures up to 1700 degrees

A COMPLETE LINE OF RESIDENTIAL AND LIGHT CONSTRUCTION MODELS

SIZES AVAILABLE
4 INCH
5 INCH
6 INCH
7 INCH

SIZES AVAILABLE
8 INCH
9 INCH
10 INCH

12 INCH

Patents
U.S. 3,722,372 and 2,855,874
British 803,920
Canadian 593,817
Other patents pending

10175-QD

WRITE FOR NEW LOW PRICES ON ALL THESE MODELS

HEAVY-DUTY INDUSTRIAL UNITS AVAILABLE
12" 14" 16" 18" 20" 22" 24" 30"
Larger sizes can be made to order

For corrosive service all Quickdraft units are available in standard acid-resisting vitreous enamel, 316 stainless steel, rigid plastics (P.V.C) and with plastic or Fiberglas coatings.

Quickdraft CORPORATION
P. O. Box 87-O
Canton 1, Ohio

For more data circle this page number on card at back of book

dpa

HORIZONTAL SPLIT CASE—DOUBLE SUCTION, SINGLE STAGE PACKED PUMP

Capacities to 2800 GPM

Heads to 290 Feet

Discharge Sizes 1½ to 8 inches inclusive

Temperatures to 250° F.

A NEW, QUIET, VIBRATIONLESS PUMP

The new Chicago DPA pump is an exceedingly sturdy, quiet unit providing maximum hydraulic efficiency at all times. Suction, discharge openings and bearing housings are integrally cast into the lower case for maximum rigidity and perfect alignment.

Positive impeller positioning is assured at all times due to a novel and proven design of the rotating assembly. Removal of the entire rotating assembly for inspection is made easy and exact re-alignment assured.

The cast bronze impeller is hydraulically and dynamically balanced and the water passageways hand ground for smooth vibrationless operation. The extra deep stuffing boxes are tapped and bronze lantern rings provided for connection of water sealing.

For further information contact your local Chicago Pump Distributor or write direct for Bulletin 102-A.

fmc
FOOD MACHINERY AND CHEMICAL CORPORATION

Putting Ideas to Work

FOOD MACHINERY AND CHEMICAL CORPORATION
HYDRODYNAMICS DIVISION
CHICAGO PUMP

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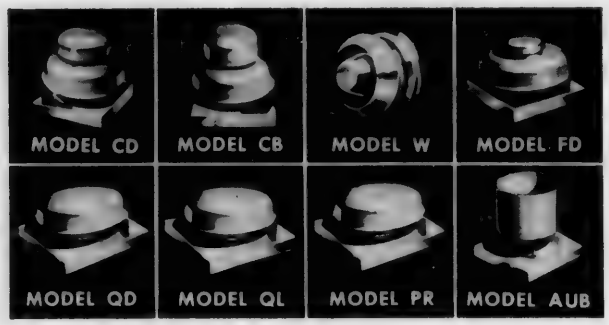


how to design for lower costs . . . . . without sacrificing quality

Cook ALL ALUMINUM VENTILATORS

. . . . . THE ONLY VENTILATOR WITH 5 YEAR WARRANTY OFFERS THESE COST CUTTING FEATURES

REDUCE ROOF LOAD

Lightweight All Aluminum construction permits use of lighter roof supporting members. Important in large installations.

CUT INSTALLATION TIME

Designed for simple installation, Cook Ventilators save time and money.

ELIMINATE SERVICE CALLS

Fine construction—efficient design assures proper performance without tinkering. Install it—forget it.

GUARANTEE SATISFACTION

Corrosion resistant Aluminum construction cuts maintenance to the bone. Design and construction assure top performance—long trouble-free life.

You'll find a Cook Ventilator that comes closest to meeting your specific requirement in the complete Cook line. Specifications on all products are included in our new catalog. Send for your copy today!
See it also in Sweets Architectural File.

WRITE NOW FOR OUR 1961 CATALOG

Cook ALL ALUMINUM VENTILATORS
THE LOREN COOK COMPANY
BEREA, OHIO MEMBER AMCA

For more data circle this page number on card at back of book

(Continued from page 162)

New Capacities Added

New capacities in its direct-fired heater line are announced by Jackson & Church, division of York-Shipley, Inc., York, Pa. The new sizes, from 2,000,000 to 4,000,000 Btu, double the capacity of the previous direct-fired line. These heaters are available for firing with light oil, gas, heavy oil and combinations of these fuels.

This complete line is said to be particularly adaptable for heating large open areas such as warehouses, foundries, factories and also to duct systems for schools, churches, and public buildings. And, according to the company, extremely high efficiency is obtained in these direct-fired units through use of the JC Unifuel burner. The burner, developed some years ago and field tested extensively, is equipped with high-low fire electronic flame scanning equipment, automatic electronic controls and a forced draft air/fuel atomization process for economical operation.

More Information? Circle Item 88 on Inquiry Card.

Laboratory Hose Cock

A Lab-Flo laboratory fixture, needle hose cock model BL-4010-1, capable of withstanding high pressure, is introduced by T & S Brass and Bronze Works, Inc., Westbury, L. I., N. Y.

Floating needle point is stainless steel to resist corrosion and provide greater wear. Heavy duty valve contains no packing and is heavily chrome plated. Unit is said to permit fine, regulated control and is suitable for rare gases as well as for gas, air, and vacuum. A fluted bakelite control knob is provided with colored plastic index.

More Information? Circle Item 89 on Inquiry Card.

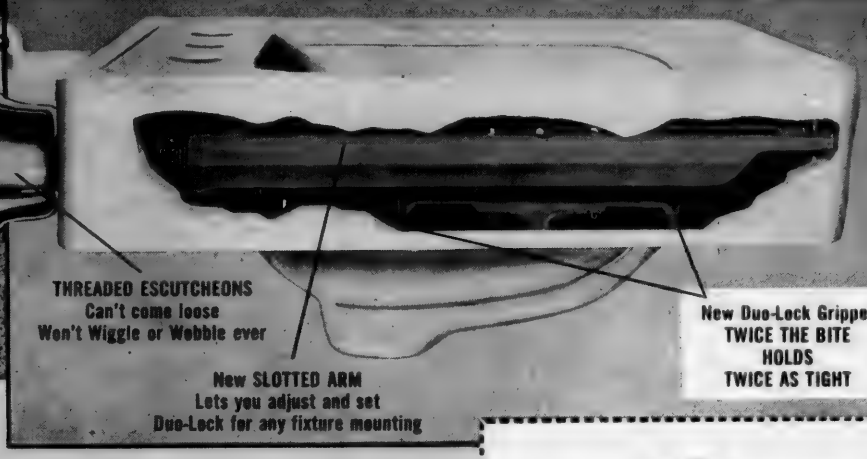
(Continued on page 166)

LAVATORIES Can't WORK LOOSE

ONCE THEY'RE INSTALLED ON THESE NEW

JAY R. SMITH

"SURE SET" Concealed Arm LAVATORY CARRIERS



NEW "SURE SET" CARRIER ARM

SUPPORTS EACH FIXTURE RIGHT AND HOLDS IT TWICE AS TIGHT

Now you can specify and install any concealed arm lavatory on these new Smith "SURE SET" Carriers and know that they are "SET FOR SURE and WILL STAY SECURE." Designed to eliminate any possibility of Lavatory fixtures working loose or becoming shaky once they've been installed, this new "SURE SET" design now makes it easier to "SET 'EM", then "LETS YOU FORGET 'EM."

NEW DUO-LOCK GRIPPER — provides twice the bite, to hold twice as tight.
You'll find no flimsy, off center locking device or toggle bolts to work loose on this carrier . . . A new adjustable DUO-LOCK Gripper, grips the center of the fixture with a well spaced, double wedged, balanced bite that secures and holds the fixture twice as tight, so fixtures can't work loose once they're set

SLOTTED ARM ADJUSTMENT — . . aligns the Duo-Lock with every fixture.
"SURE SET" slotted arms let you slide and set the Duo-Lock Gripper at the exact position required to align the take up screw with the punchings in each fixture

THREADED ESCUTCHEONS — Can't wiggle, wobble, or loosen ever.
Heavy cast chrome plated escutcheons, thread directly onto each carrier arm to insure perfect alignment and hold it permanently tight.

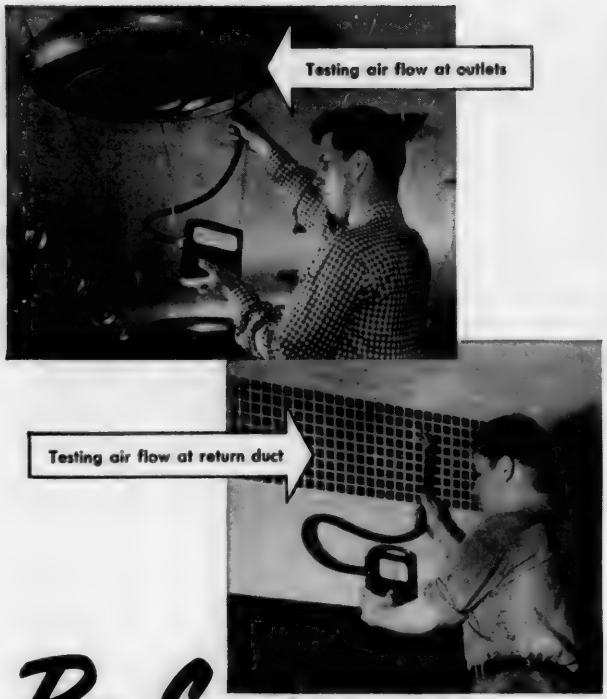
ADJUSTABLE THREADED ARMS — . . for easier installation and adjustment.
With this carrier there are no set screws to get buried in the wall and cause trouble, . . . for these "SURE SET" Arms thread directly into the carrier support brackets, to make it easy to install and adjust the carrier arm length to the exact dimension required, after the finished wall is installed.

IRIDITE PROTECTIVE PLATED — . . against rust and corrosion.
Each "SURE SET" Arm assembly is plated with Gold Bright IRIDITE which provides three times more protection against rust and corrosion than even previously used cadmium plating.

JAY R. SMITH MFG. CO. Union, New Jersey — PLUMB-EASY

CHAIR CARRIERS · DRAINS · INTERCEPTORS · HYDROTROLS

For more data circle this page number on card at back of book



Be Sure the first time
in balancing air flow systems

The Alnor Velometer®

gives a quick accurate check of air movement at outlets, returns, plenum chambers, static pressure in ducts, friction loss at ells and deflectors.

Readings are made directly in f.p.m. on the Velometer dial. So sensitive, readings as low as 20 f.p.m. can be made. The triple range scale registers up to 3000 f.p.m. and 6000 f.p.m.

Velometer Set No. 3G

Recommended for the air conditioning, heating and ventilating contractor. Consists of the Velometer with rugged carrying case, angle supply jet, suction (return) jet, static pressure jet, Price f.o.b. Chicago $194.

Velometer Jr.

For quick simple checking at outlets where attachments are not required. A compact instrument only 4" x 3" x 1½". Capacity ranges

0—200 f.p.m. to 800 f.p.m.
0—400 f.p.m. to 1600 f.p.m.
0—500 f.p.m. to 2500 f.p.m.

Price, with genuine leather carrying case, $44.00 f.o.b. Chicago. All models carried in stock for immediate delivery.

Alnor INSTRUMENTS

ALNOR INSTRUMENT CO.
Division of
Illinois Testing Laboratories, Inc.
Rm. 570, 420 N. LaSalle St., Chicago 10, Ill.

For more data circle this page number on card at back of book

(Continued from page 164)

Return Air Grilles

No. 64 high capacity return air grilles, for use in central return air systems, general ventilation, or for providing combustion air in utility rooms, are offered by Hart & Cooley Mfg. Co., Holland, Mich.

According to the manufacturer, angular fin design, used only with these grilles, provides much greater free area than can be obtained with curved or flat fins; so much so, that smaller sizes can frequently be used and worthwhile savings effected.

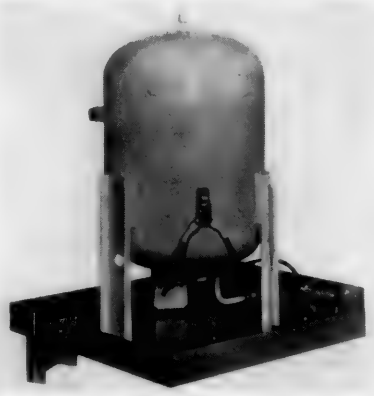
More Information? Circle Item 90 on Inquiry Card.

Winter Condensing Pressure Controls

A line of winter condensing pressure controls for air-cooled systems which must operate at low outdoor temperatures is introduced by Carrier Air Conditioning Co., Syracuse, N. Y.

Four sizes of controls suitable for use in systems of 5 through 15 tons capacity are offered. Multiple units can be installed in larger systems. Advantages include modulation control with no valves or moving parts other than a standard thermostat.

The new unit (Model 33AA) consists of a pressure vessel equipped with a thermostatically-controlled heater, all enclosed in an insulated casing. The control



is teed into the liquid line of the refrigerant circuit. The thermostat is set to maintain the refrigerant inside the vessel at 90 deg F.

During winter operation, when the saturated condensing temperature drops below 90 deg, the thermostatically-controlled heater cuts in. Heat vaporizes the refrigerant in the condenser and forces liquid refrigerant out the bottom of the vessel and into the refrigerant circuit. The excess refrigerant accumulates in the condenser and reduces the amount of effective condensing surface, causing the condensing pressure and the saturated condensing temperature to rise.

This action continues until the condensing temperature reaches 90 deg. Above this temperature, refrigerant will return to the condensing pressure control vessel.

More Information? Circle Item 91 on Inquiry Card.

Anti-Smoke Fuel Oil Additive

A new product said to help large-scale fuel oil users deal with a vexing air pollution problem, exhaust of black smoke from stacks, has been developed by Metropolitan Refining Co., Inc., Long Island City, N. Y.

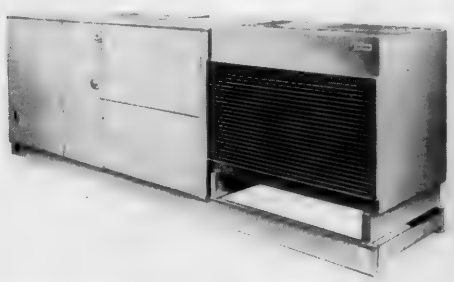
Marketed under the trade name Liquid Sludgout P-60, this all-purpose fuel oil additive and soot remover is formulated for use with residual fuels known as Bunker C or #6 fuel oil. It causes more complete combustion of residual fuel oils and eliminates soot, the company states.

The product also keeps residual fuel oils in standby and idle storage tanks ready for immediate use, and prevents serious corrosion of the storage tanks themselves. (The manufacturer states that this is important since many industrial plants using natural gas keep their oil burning facilities available for standby or emergency use. A growing number also are finding it not only economical but necessary to alternate the use of gas and oil, depending upon the prevailing prices and the supply picture for the respective fuels.)

More Information? Circle Item 92 on Inquiry Card.

Roof-Top Heating-Cooling Line

A roof-top heating or cooling or year round conditioning line, known as the Skyliner, is announced by Janitrol Heating and Air Conditioning, a division of Midland-Ross Corp., Columbus, Ohio. Designed especially for use with one-story buildings, the unit features gas-fired heating and air-cooling in a variety of capacity combinations.



The unit circulates the conditioned air through a short concentric supply-return duct and ceiling diffuser, located directly beneath the unit. No duct system is needed; no useable inside space is used. It has a low silhouette and no vent stack is required since a flue gas exhauster is furnished. One or more units, as desired, may be used to provide a simple zone-controlled comfort system, since each Skyliner is independent and individually controlled by its own thermostat.

Unit is described as factory assembled, wired, tested and ready for operation with a minimum of installation time.

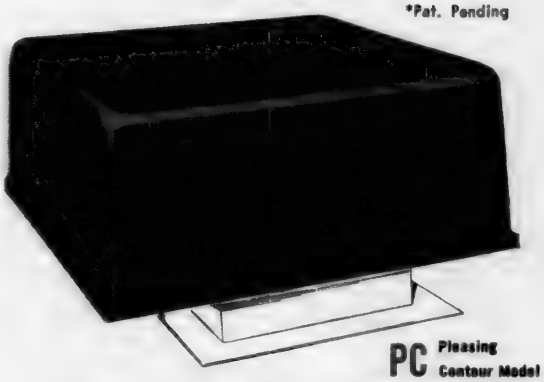
More Information? Circle Item 93 on Inquiry Card.

Introducing . . .

DAVIDSON

Roof Exhaust Fans with Fiberglass Housings* in COLOR!

*Pat. Pending



PC Pleasing Contour Model

Now . . . an extensive line of low-profile PC Fans is available with your choice of six sealed-in colored housings: light blue, dark blue, tangerine, buff, gray and white.

These new housings deaden sound, require no maintenance and withstand all elements. This new dimension in styling . . . plus all the advantages of Davidson Hyduty PC Fans:

- Famous Davidson rugged construction
- NEMA Standard Motors
- Vibration-isolated construction
- Ratings conform to Standard Test Code

For complete facts, write:

DAVIDSON FAN CO.

Dept. G, 213 California St.
Newton 58, Mass.

The original manufacturer of roof fans — Founded 1915

Charter Member AMCA

For more data circle this page number on card at back of book

FLEXIBLE METAL HOSE & TUBING

HEAT RESISTANCE + PRESSURE RESISTANCE
+ CORROSION RESISTANCE + FLEXIBILITY

- Absorb expansion
- Isolate vibration
- Correct misalignment
- Compensate offset motion
- Continuous flexing
- Reciprocating motion
- Loading hose, and all extreme bending and flexing applications.

ALLIED'S wide range of IN-STOCK standard flexible metal hose connectors will solve your pipeline-motion problems FAST.

ALLFLEX

"MNH" FLEXIBLE METAL HOSE CONNECTORS

STAINLESS STEEL • BRONZE • MONEL
SAME DAY SHIPMENT on ALL THESE STOCK SIZES:
¼" ⅜" ½" ¾" 1" 1¼" 1½" 2" 2½" 3" 4"
EACH IN ALL THESE STOCK LENGTHS:
12" 18" 24" 30" 36" 48" 60" 6 ft. 8 ft. 10 ft. 12 ft. 15 ft.

"TOMORROW" shipment of any length, with any end fitting connection. S/S to 16", Bronze to 8", Monel to 4".

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- STAINLESS STEEL
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Tames Vibration and Compensates for expansion on EXHAUST and AIR INTAKE LINES
SIZES: Thru 16"
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Absorb pipeline expansion • Installed at right angles to direction of movement • Custom engineered to solve your specific problem • For pipelines thru 16" size • Temperatures to 1200°F.

All Alflex products available with all standard or special couplings and flanged end connections. Write, wire, phone today for your ALLFLEX DATALOG and name and address of your nearest ALLIED FLEXOLOGIST.

Heating, Airconditioning & Piping Division

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For more data circle this page number on card at back of book

PREFABRICATED BATHROOMS

(Continued from page 18)

my observation that their materials are inferior to ours. The same holds true as to their standards of accuracy. In short, except for their methods of curing concrete by steam, enabling them to turn out finished walls in seven hours, they could not in any way be said to excel our methods."

At the Industrial Exhibit in Moscow, Mr. Scott witnessed the operation of a portable automatic welding machine used for cross pipe lines. This equipment performed quite satisfactorily, he said. "It was rapid, and I was assured that the welds easily pass X-ray inspection. I have seen nothing like it in this country and . . . . . I believe (it) might interest our industry", he said.

Visits England and France

In England, Mr. Scott spent a considerable amount of time with Macklin Floyd, European representative for Stone & Webster. "Mr. Floyd stated," commented Mr. Scott, "that in his opinion Great Britain has come up with no developments since the war superior to or that would even seriously challenge American methods; that the design work of the British is based entirely on American lines of procedure."

In France, Mr. Scott visited four different organizations. The first was a steel pipe manufacturing establishment. "The firm has developed a drive type of fitting, unsuited for pressure but very advantageous for pipe used as railings, fences, scaffoldings and supports," he stated.

"It is not yet on the market, but within a short period I shall receive further information on its uses. I believe that the product can be used to supplant wood with pipe for many purposes, thus increasing business and sales opportunities for our industry."

The second operation Mr. Scott observed was a plastics firm. "They have developed a plastic panel," he continued, "which will handle water up to 400 deg F. It is inexpensive, incidentally, and

has been used in a number of large installations. It may be a satisfactory substitute for warm air and I am attempting to get more information about it."

The third organization Mr. Scott visited was the Coframet firm. "Coframet has had considerable experience in the development of water purification systems and will send me information on what the French are planning to do for the Sahara and Middle East areas," Scott said, adding that he had promised to send reciprocal information about water purification methods and research on the subject in this country.

The fourth and final installation Mr. Scott visited in France was a company in the business of manufacturing fittings and purported to have unique ideas on copper pipe soldering. "Here I was disappointed, finding nothing new or of interest to the industry," Mr. Scott wound up.

UNIVERSITY OF CALIFORNIA OFFERS CORRESPONDENCE COURSE

For the first time, a major university is offering a nation-wide correspondence course to aid engineers prepare for professional registration. Titled *Engineering Fundamentals*, the course was developed for the University of California by Lloyd M. Polentz, P.E., noted engineering consultant, author and lecturer.

More than 100 examinations utilized by 35 states were analyzed by Polentz during a three-year period of research and preparation. The new correspondence course is designed to be of benefit to all engineers preparing for the first, or closed-book, portion of the engineering registration examination in any of the 50 states or three territories. The course is also aimed at engineers who wish to review fundamentals as an aid to current work or in preparation for advanced study.

Further information and application for enrollment may be obtained from the Department of Correspondence Instruction, University Extension, University of California, Berkeley 4, Calif.

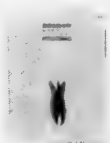
Satisfy more "tough clients" with Reznor

NEW AUTOMATIC VENTER lets you install Reznor unit heaters almost anywhere!

Now, with the Reznor Venter, you can install direct-fired Reznor heaters where you couldn't before—in multi-story buildings or structures with hard-to-get-at chimneys! You'll save money for your "tough clients."

The Venter, available exclusively with Reznor Heaters, is a motorized automatic vent exhauster that mounts directly on the heater. A 4-inch diameter vent pipe is all that is needed to carry burned gases to a sidewall—or down through the floor and out, if you choose. No more costly roof venting or big, expensive flues. Heaters operate more efficiently, too, especially if the room has an exhaust fan which creates a negative pressure.

There's a Venter for all Reznor Heaters up to 300,000 Btuh. Ask your representative for Catalog SA-5900, with data on all Reznor Heaters and the new Venter. Or write Dept. 64-Q, Reznor Manufacturing Co., Mercer, Pa.

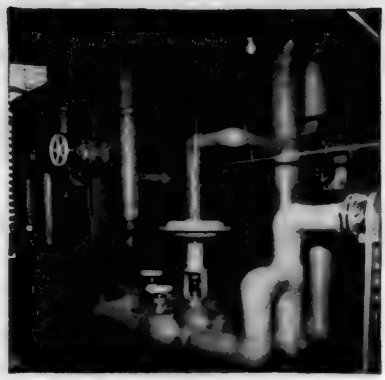


USE THE REZNOR VENTER AND AVOID THESE PROBLEMS:

REZNOR HEATERS

"WORLD'S LARGEST SELLING DIRECT-FIRED HEATERS"

DRY AIR...
PRECISELY AS YOU NEED IT



NIAGARA CONTROLLED HUMIDITY AIR CONDITIONING

removes atmospheric moisture by direct contact with an absorbent liquid in a compact spray chamber. The spray contact temperature and the concentration of the absorbent liquid, two factors that are easily controlled, determine precisely how much moisture remains in the air leaving the unit.

This Niagara Controlled Humidity method, using Niagara Hygrol Absorbent Liquid is....

The only really precise method of air conditioning because it removes moisture as a separate function from heating or cooling to give you assurance of accuracy of air moisture control.

It is the most reliable because the absorbent is continuously and automatically kept at the proper concentration. No moisture-sensitive instruments are required to control your conditions.

It is the most flexible because with it you can either hold the precise condition you need as long as you wish or vary it with accuracy.

It is easiest to operate and maintain because the equipment and controls are simple and trustworthy.

This method is successfully used in the storage, testing and production of hygroscopic materials, in process control and as a pre-dehumidifier in comfort air conditioning.

Write for Bulletins Nos. 122 and 140.
Address Dept. HV-2

NIAGARA BLOWER COMPANY
405 Lexington Ave., New York 17, N. Y.
District Engineers in Principal Cities of U. S. and Canada

For more data circle item 170A

BRIEFLY STATED

NEWS ITEMS

WITH THE ENGINEERS

GINOCCHIO, CROMWELL, CARTER, DEES & NEYLAND is the new name of Ginocchio, Cromwell & Associates, architects and engineers, 416 Center Street, Little Rock, Ark. Partners are: Frank J. Ginocchio, AIA; Edwin B. Cromwell, AIA; Charles B. Carter, AIA; Ben W. Dees, PE; Dietrich Neyland, AIA; Robert H. Millett, AIA; and John J. Truemper, Jr., AIA. Associates are: Oliver W. Gatchell, Jr., PE; Wm. Harold Grant, PE; and David E. Blaine. . .

Daniel T. Webster, Jr. is now associated with SEELYE STEVENSON VALUE & KNECHT, 101 Park Ave., New York, N. Y., as consultant. He was formerly general manager, Guy B. Panero Engineers. He had been with that firm for 14 years. . .

CUMMINS & BARNARD, INC., CONSULTING ENGINEERS, are opening a branch office in the California area through professional association with MATSON ASSOCIATES, CONSULTING ENGINEERS, 14568 Whittier Blvd., Whittier, Calif. . .

Erich J. Kocher, chief engineer of THE VILTER MANUFACTURING COMPANY, has been elected a director of the Milwaukee manufacturer of industrial refrigeration and air conditioning equipment. Mr. Kocher joined Vilter in 1937 and has served in both manufacturing and engineering capacities before being named chief engineer in 1945. . .

The retirement of Richard D. Madison after forty-one years of service has been announced by BUFFALO FORGE COMPANY. Joining the company in 1919, he was appointed director of research in 1954 and has served subsequently as an engineering consultant.

Dwyer

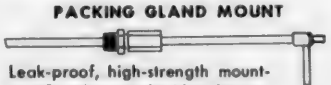
STAINLESS STEEL PITOT TUBES

INCH-SCALED TO SHOW DEPTH OF INSERTION

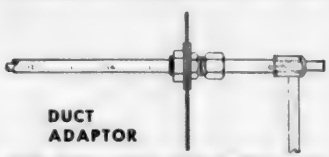
Dwyer No. 160 Pitot Tube being used to check air velocity with a No. 1010-1 Magnehelic Gage.

With inch graduation inscribed on *both* sides of the Dwyer Pitot Tube, you find the exact center of any duct immediately and make an accurate traverse. These Dwyer units feature lifetime stainless steel construction, accurate burr-free static holes and test-confirmed unity coefficients. They're available in a complete range of sizes from 12" to 60". With the mounting accessories shown below, they can be used for checking air velocities and static pressures in any kind of service. Dwyer Pocket-Size Air Velocity Calculator supplied with each Pitot Tube.

PACKING GLAND MOUNT



Leak-proof, high-strength mounting. Stainless steel with asbestos-graphite seal. For hazardous gases, etc.



DUCT ADAPTOR

Split ferrule allows tube position to be changed without disconnecting. Solid brass construction.

SPLIT FLANGE MOUNT

Split halves, neoprene gasket and hardware supplied for attaching to any duct. Fits all standard pitot tubes.

F.W. DWYER MFG. CO.
P.O. Box 373-N Michigan City, Ind.

For more data circle item 170B

Perhaps best known, internationally, as the four-edition editor of the Buffalo Forge handbook "Fan Engineering," Mr. Madison has contributed a considerable number of papers in the field. His paper on the subject of elbow loss is a standard reference while others are recognized in the general field of sound and vibration in connection with both fans and ventilating systems. . .

Appointment of John A. Holbrook, a specialist in hospital and institutional engineering problems, to the staff of A. T. Kearney and Company, Chicago-based management consultants, was announced. Prior to joining the Kearney company, Holbrook served as administrative engineer at Presbyterian-St. Luke's Hospital where he helped to direct that institution's recent $18 million building program.

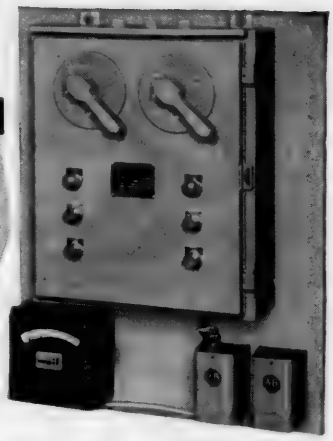
NAME CHANGE

Detroit Controls Division of American Radiator & Standard Sanitary Corp., Detroit, Mich., announce that the division's new name is AMERICAN-STANDARD CONTROLS DIVISION. The new name is in keeping with its steady growth pattern during the past few years, consequent broadening of its product lines, and geographical expansion of the division's manufacturing operations beyond Detroit. Besides Detroit, major plants also are located at Stratford, Conn., and Rochester, N. Y., where American-Standard last month acquired Rochester Manufacturing Co., Inc.

SOCIETY BRIEFS

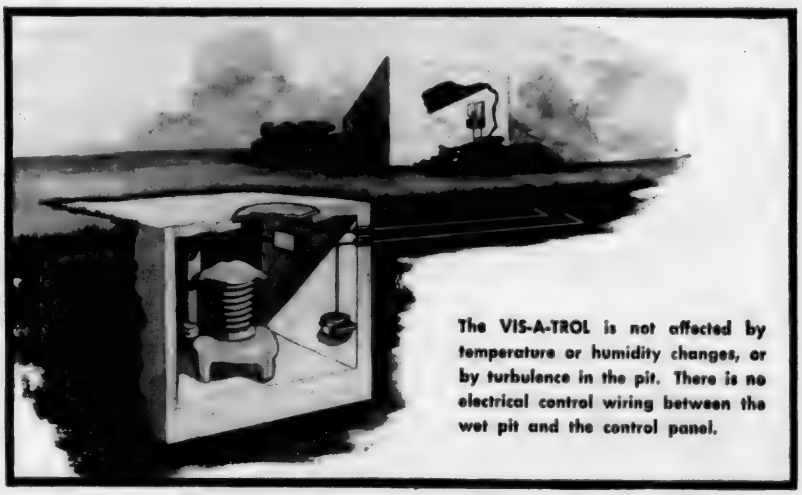
At the January 16 bi-monthly meeting of the West Coast chapter of GAS APPLIANCE ENGINEERS SOCIETY, Los Angeles, Calif., a panel from the Los Angeles and County Building Departments discussed codes and ordinances affecting gas appliances. Their installations were the primary subject. A question and answer period moderated by Frank Day, Grayson Controls Company, followed. GAES president is Wally

the weil VIS-A-TROL
AUTOMATIC PUMP CONTROL and LIQUID LEVEL INDICATOR



for weil
- Submersible sewage and sump pumps
- Vertical type sewage and sump pumps
- Septic Tank effluent pumps

The weil VIS-A-TROL automatic control system is combined with a depth measuring device which shows the depth of liquid in the pit. The pumping rate can be compared with the in-flow at all times without looking into the wet pit. It is indicated on the instrument and responds instantly to level changes in the sump.



The VIS-A-TROL is not affected by temperature or humidity changes, or by turbulence in the pit. There is no electrical control wiring between the wet pit and the control panel.

The VIS-A-TROL can be installed in outside weather-proof enclosures or installed within a building and may be located as much as 300 feet away from the pumping pit. High and low limits of liquid level control are set at the instrument. It is never necessary to go into the wet pit for control adjustment.

See your weil representative or send for Bulletin AC-100

See the weil VIS-A-TROL and other new weil products at Booth 954-958 International Heating & Air-Conditioning Exp. Feb. 13th to 16th.

weil PUMP COMPANY

STAY ONE STEP AHEAD WITH weil

1516 North Fremont St. • Chicago 22, Ill.

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Kennedy of Charles Koch and Associates, 3134 East Olympic Blvd., Los Angeles. . .

Three ARMOUR RESEARCH FOUNDATION staff members were elected to top posts in the MIDWEST AIR POLLUTION PREVENTION ASSOCIATION, INC. New president of MAPPA is Daniel A. Sullivan, ARF consultant. Lewis Evans, Chicago & Indiana Railroad Co., was re-elected first vice-president. Second vice-president for the coming year is Dr. George S. Gordon, ARF director of chemistry research. Douglas R. Fuller, Northern Trust Co., was re-elected treasurer of MAPPA; and Dusan Ljubenko, administrative supervisor, ARF chemistry research division, was elected secretary. . .

Anthony Dvorak, a prominent plumbing contractor in Chicago, has been named executive secretary of the PLUMBING CONTRACTORS ASSOCIATION of Chicago to succeed William M. Readey who resigned, after over ten years of service. He has been a member of the Association for many years, and served in the capacity of chairman of the Labor Relations Committee, playing an important part in bringing about a closer relationship and cooperation between labor and management. . .

W. G. Kirkland and R. E. Paret have been elected assistant vice-presidents of AMERICAN IRON AND STEEL INSTITUTE by the Institute's Board of Directors. Mr. Kirkland's duties will be in the field of building research and technology and Mr. Paret's in the promotion of the uses of steel. . .

Walter McCarty, Chicago, was elected national president of REFRIGERATION AND AIR CONDITIONING CONTRACTORS ASSOCIATION at the recently concluded RACCA national convention held in Miami. Mr. McCarty will guide the association's industry-wide promotion and education program during 1960-61. New officers elected to serve with McCarty are: Don Kissel, Los Angeles, first vice-president; Brooks Reeder, Detroit, second vice-president; Robert Lafferty, Miami, recording secretary; Harvey Hottel, Washington, D.C., treasurer; and Joseph Marchase, Pittsburgh, sergeant-at-arms. . .

Construction of the coal industry's new central research laboratory on a 30-acre site in Monroeville, East Pittsburgh, Pa., is under way. Stephen F. Dunn, president of the affiliated organizations, NATIONAL COAL ASSOCIATION and BITUMINOUS COAL RESEARCH, INC., said that construction culminates the decisions made in June by the Boards of Directors of these organizations and will permit the consolidation of the coal industry's research activities now being conducted in Columbus, Ohio and Pittsburgh, Pa. The building, when completed and equipped, will be worth in excess of $1 million. The new research center will be under the direction of James R. Garvey, BCR vice-president and director of research. . .

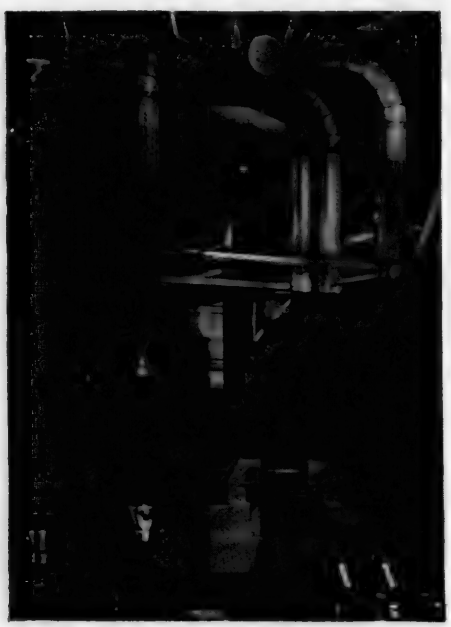
NEW REPRESENTATIVES

MODINE MANUFACTURING COMPANY, Racine, Wis., announced appointment of new commercial heating and air conditioning equipment representatives for Virginia and for metropolitan Washington, D. C. Luther A. Prillaman, Richmond, Va., is the representative for all of Virginia except the area around Washington, D. C. John R. Newman, Kensington, Md., will cover the metropolitan Washington territory, including several counties in Maryland and Virginia. . .

Albert A. Duckett, for 20 years the Southern New Jersey distributor for CARRIER AIR CONDITIONING COMPANY, has been assigned the Carrier franchise for the Greater Boston area, all of Rhode Island and eastern Massachusetts. His new firm, known as Duckett Distributing Corporation, 150 Causeway Street, Boston, will operate 100% wholesale, including stocking, warehousing, financing, service parts, engineering, training, sales, advertising and promotions for the dealer, contractor and appliance store. . .

General Heating & Cooling Company, Kansas City, Mo., has been named distributor for CAR-

YOU SAVE MORE WITH FLEXAUST® HOSE



Thousands of successful installations prove that use of Flexaust hose and Portovent retractable duct with metal duct systems lower installation costs — but there are other important advantages

Exceptional abrasion resistance
Corrosion resistance
Noise absorption
Durability under heavy flexing
Provision for expansion and contraction
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Made of high quality neoprene coated fabrics 1¼ to 36" i.d.

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RIER AIR CONDITIONING COMPANY, serving northern and eastern Kansas, the western half of Missouri and a few counties in Arkansas. The firm's Kansas City headquarters, at 2101 Broadway, distributes unit heaters, insulation, humidifiers, pumps, electric heating, grilles and registers, gas vent pipe, furnace pipes and fittings in addition to Carrier air conditioning equipment. . .

Hausman Steel Company, Toledo, Ohio, a distributor for CARRIER AIR CONDITIONING COMPANY, has been assigned the Carrier franchise for the Greater Indianapolis area, doubling the size of its sales territory. The 42-year-old firm, which also serves the Fort Wayne area, has been in the air conditioning business for 11 years. The former Indianapolis distributor, Indiana Weathermakers, will remain in the air conditioning contracting business as a Carrier dealer. . .

Formation of two foreign subsidiaries to serve the European common market and the United Kingdom was announced by THE TRANE COMPANY, La Crosse, Wis. Robert P. Yeomans, Trane general counsel and secretary, has been elected vice-president with responsibilities for foreign operations, except for Canada. Mr. Yeomans will also head both new subsidiaries—Trane S.A. in Europe, and Trane Ltd. in England. . .

JOHN J. NESBITT, INC., a Philadelphia-based manufacturer of heating, ventilating and air-conditioning equipment, will shortly acquire the assets of NORMAN PRODUCTS COMPANY, Columbus, Ohio, manufacturers of gas-fired heating, ventilating and air-conditioning equipment. Norman Products Company would continue under its same management, as a division of Nesbitt, with Edward A. Norman continuing as president. No changes in the personnel nor in the policies of the Norman Products Company are contemplated. Mr. Norman has been active in the gas industry since 1933, and has served as president of the Gas Appliance Manufacturers' Association and as a director of the American Gas Association.

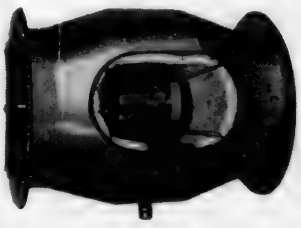
See us at the show—BOOTH 572

Here are DOERR motors at work!

AIR-COOLED CONDENSERS

(Left) **KRAMER TRENTON CO.** Unicon, designed for large capacity installations.

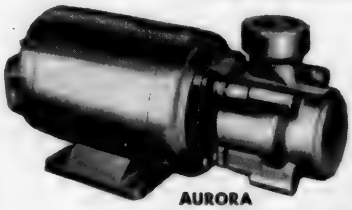
(Right) Type AC5A unit offered by the **TRANE CO.** For use with packaged air conditioners.



Induced draft bifurcator made by **DE BOTHEZAT FANS** Division of American Machine and Metals, Inc. Motor is special variable-speed type with Class B insulation for high temperature operation.

YOUNG RADIATOR CO. cabinet-type heater with cover removed to show double-shaft blower motor.

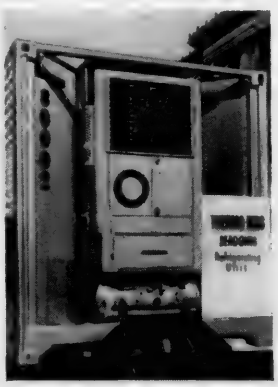
AIR CONDITIONING PUMPS



AURORA

Circulating pumps designed for cooling tower service in sizes from ¼ to 7½ hp.

INGERSOLL-RAND



Large trailer truck refrigeration unit by **THERMO KING CORP.** for intercoastal shipping. Stand-by power furnished by 7½ hp. DOERR motor with protective features for use in salt water atmosphere.

THESE leading manufacturers and many others are getting *more* by using Doerr motors.

Our fifth consecutive appearance in the Heating and Air Conditioning Exposition indicates our interest in this important field.

The variety of designs required by the applications shown is proof of our willingness and ability to meet special design problems.

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He is currently a director and chairman of the House Heating Advertising Committee of GAMA, and a member of the Advisory Council and Gas Development Committee of the American Gas Association. Nesbitt's gas-fired propeller fan unit heater will be added to the Norman line of gas-fired products. Manufacture of all gas-fired products sold by both companies will be consolidated in the Norman Products Company plant in Columbus, Ohio. . .

A new and comprehensive marketing program, which, the company states, will trigger a new trend in wholesaler-manufacturer relations in the plumbing and heating, industrial, electrical, warm air, refrigeration and air conditioning markets, was announced by MODINE MANUFACTURING COMPANY, Racine, Wis. The program is designed to sell *through*, rather than *to*, wholesalers. In essence, the company and its wholesalers will be "sales partners", with the entire Modine organization at the disposal of the wholesaler. The number of products to be sold exclusively through wholesalers has been more than quadrupled. Objective of the program is to insure coverage of all market areas with a minimum of overlap.

AMCA
Certified Ratings

YOUR ASSURANCE OF PROPERLY RATED PERFORMANCE IN AIR MOVING DEVICES

The AMCA program of Certified Ratings provides assurance of properly rated performance to specifiers and users of centrifugal fans, axial and propeller fans, power roof ventilators and other air-moving devices. To qualify for license under the Certified Ratings Program, manufacturers must meet the following basic requirements:

A manufacturer must publish performance ratings developed in accordance with AMCA's Standard Test Code, and based on tests conducted in laboratories approved by AMCA.

These published performance ratings must be developed for various volumes, pressures and speeds—at a stated density...

...and are subject to periodic re-evaluation under AMCA's continuing retest program. Authority to use the Certified Ratings Seal may be withdrawn by AMCA for non-conformance with any requirement of the Program.

When you see the Certified Ratings Seal on a manufacturer's published performance data or product, you are assured that the air-moving devices you specify have been properly rated, and meet all requirements of the Air Moving and Conditioning Association's Certified Ratings Program. For additional information, mail coupon below.

AIR MOVING AND CONDITIONING ASSOCIATION, INC.
2159 Guardian Building, Detroit 26, Michigan

Please send Bulletin 211—The AMCA Certified Ratings Program for Air Moving Devices

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PERSONNEL ITEMS

Four major shifts in the top executive ranks were announced by the JOHNSON SERVICE COMPANY. Joseph A. Cutler, president and general manager of the company since 1938, has been elevated to chairman of the board, a position vacant since the death of Harry W. Ellis in 1949. Named to succeed Cutler as president is Richard J. Murphy, executive vice-president and treasurer since 1957. Louis V. Zacharyasz, formerly secretary and assistant treasurer of the company, was promoted to secretary and treasurer. Richard P. Franz is the new assistant treasurer. . .

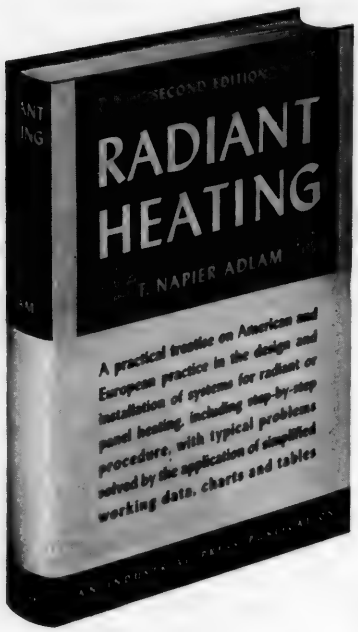
Arnett Smiley, a veteran of eighteen years with the YORK DIVISION, BORG-WARNER CORPORATION, has been named as manager of refrigeration sales. He has most recently been serving as refrigeration sales engineer with headquarters in Cincinnati, Ohio, and replaces William H. Divine, who was appointed assistant general sales manager of York's Engineered Machinery Division. . .

C. Gilmore Ruston has been appointed president of AMSTAN SUPPLY DIVISION OF AMERICAN-STANDARD. He succeeds Robert F. Sells, who is retiring after 38 years service with the company. Prior to his new appointment, Mr. Ruston was vice-president, field operations of Amstan Supply, which operates 63 wholesale branches throughout the country, distributing plumbing, heating, air conditioning and industrial supplies. Headquarters of the division are in Pittsburgh, Pa. . .

In a move which solidifies the

(Continued on page 176)

Here is a Book You Cannot Afford to be Without!


SECOND EDITION
RADIANT HEATING
T. NAPIER ADLAM
A practical treatise on American and European practice in the design and installation of systems for radiant or panel heating, including step-by-step procedure, with typical problems solved by the application of simplified working data, charts and tables

What do you want to know about radiant heating? Here is a book that gives you the answers — the right answers—written by an outstanding authority on the subject. "Radiant Heating" by T. Napier Adlam, provides basic information plus working data necessary to design and install efficient systems . . . covers radiant heating with ceiling, wall and floor panels, using all types of fuels . . . shows step-by-step procedure in laying out systems, using simplified charts that give most of the essential data without calculation.

If you want authoritative answers to radiant heating questions, you'll find time-saving, money-saving solutions to your problems in this book. Send for your copy today!

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- ☐ How Activated Charcoal "Traps" Odors
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- ☐ Capacity of Activated Charcoal for Specific Vapors
- ☐ Hospital Odor Control
- ☐ Weigh Odor Control Methods Carefully
- ☐ Air Purification with Activated Charcoal Filterfolds

Activated charcoal acts as a positive molecular sponge which adsorbs gases, vapors, irritants, toxic substances and smog. It enables you to engineer for high percentage air recirculation at low cost.

These and many other bulletins on all applications of activated charcoal are available to you. Give us the details of your application and we will supply specific data and samples.

We supply a complete line of activated carbons for every purpose; design and prefabricate air and liquid purification, separation and recovery systems. Barnebey-Cheney, Columbus 19, Ohio.

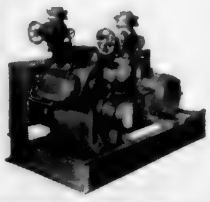
BOOTH 1111
Chicago Exposition
February 13-16

Barnebey Cheney

For more data circle item 175A on card at back of book

Summer Cooling... Winter Curling and Skating - all with ONE refrigeration system

Main entrance to Prudhomme's Garden Centre Motor Hotel in Vineland, Ontario. This exciting summer and winter playground spot uses Vilter refrigeration to good advantage.



Two 6-cyl. Vilter VMC belt-driven compressors provide refrigeration at Prudhomme's for summer air conditioning and winter curling.

The Garden Centre Theatre becomes a regulation six-sheet curling rink during the winter months. The Vilter system is designed to produce ideal curling ice at the lowest possible power cost.

Year 'round use of your refrigeration capacity is sound business and enables maximum profit to be realized from your investment.

An excellent example of the year-'round utilization of refrigeration is Prudhomme's Garden Centre Motor Hotel in Vineland, Ontario, along the Queen Elizabeth Way. At this famous motel, recreation center and convention headquarters, Vilter refrigeration plays an important role in keeping guests happy.

During the summer months, refrigeration is required to air condition the 180-room motel, one of Canada's largest, and an 1100-seat summer stock theatre which draws large crowds to see outstanding stock productions of Broadway plays. In winter months, the same equipment builds ice surfaces for a 90′ x 180′ outdoor ice skating rink and a regulation six-sheet curling rink. The summer stock theatre building is used to house the curling rink with either a seating structure installed or plastic piping laid for the curling rink, depending upon the season.

Vilter equipment installed at Prudhomme's includes two 6-cylinder VMC compressors and a 24″ x 20′ shell and tube condenser.

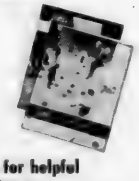
Vilter has had many years of experience in recommending and building refrigeration systems for air conditioning and ice rinks. This know-how, plus the use of dependable economical-to-operate Vilter equipment, can also mean a satisfying installation for you. Why not see your nearest Vilter representative today?

Sold and Installed by VILTER DISTRIBUTOR
J. L. Wilson and Sons, Limited, Toronto, Ontario, Canada

Vilter® refrigeration air conditioning

The Vilter Manufacturing Company
Milwaukee 7, Wisconsin

Air Units • Ammonia and Freon Compressors • Booster Compressors Baudelot Coolers • Water and Brine Coolers • Blast Freezers Evaporative and Shell and Tube Condensers • Pipe Coils Valves and Fittings • Pakice and Polarflake Ice machines.



Write for helpful bulletins to The Vilter Manufacturing Company, Dept. G-614 2217 South First Street Milwaukee 7, Wisconsin

For more data circle this page number on card at back of book

Briefly Stated

(Continued from page 174)

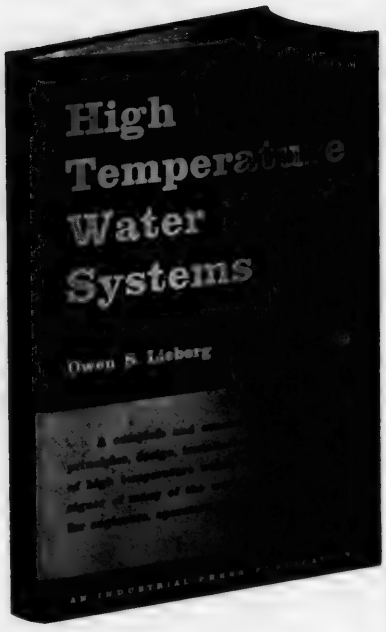
position of 58 company-owned branches, Horace R. Riggs was elected a vice-president of CRANE Co., Chicago, Ill. Mr. Riggs has been associated with Crane Co. for the past 39 years. Prior to becoming general manager of Crane Supply Co., he headed branches in Pittsburgh, Pa. and Lima, Ohio. . .

Thomas G. Lanphier, Jr., industrial executive with extensive experience as an administrator of major research and development projects for both government and business, has been elected president of FAIRBANKS, MORSE & Co., the largest manufacturing component of the Fairbanks Whitney Corporation, it was announced by David Karr, president of the parent company. As president of Fairbanks, Morse, he will continue to serve concurrently as a vice-president of the parent company. Other major industrial components of Fairbanks Whitney are Pratt & Whitney Machine Tool Co., Chandler Evans, Colt's Patent Fire Arms Mfg. Co., and "Quick-Way" Truck Shovel Co. of Denver, Colo. . .

AIR CONDITIONING INC., Ossining, N. Y., makers of Atmos-Pak roof-mounted equipment, announced the appointment of Peter J. Dalton as vice-president in charge of sales. Prior to this, Mr. Dalton was associated with Welbilt Air Conditioning & Heating Corporation in a similar capacity. Before his tenure with Welbilt, Mr. Dalton held many important executive posts including product sales manager of Worthington Corp.; regional manager for Airtemp Division of Chrysler Corporation, and the presidency of his own organization. . .

Fred F. Moore, Jr. has been elected vice-president of KENSICO TUBE COMPANY DIVISION, ROBINSON TECHNICAL PRODUCTS, Mt. Kisco, N. Y. Mr. Moore joined Kensico a year ago, as general sales manager, and will continue to head this department of the

(Continued on page 178)



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STARRING
LAYKOLD INSULATION ADHESIVE

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Here's the way a tilt-up job goes:

1. Pour wall panel on floor and let set
2. Spray on Insulation Adhesive at 23 sq.ft./gal. It helps cure the concrete.
3. Press the vapor barrier membrane into the set Adhesive.
4. Tilt the panel up into position and anchor.
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6. Press blanket-type insulation into place.

The speed and ease of this operation underscores the major advantages of Laykold Insulation Adhesive: *Spray-applied . . . cold . . . it saves time, equipment, money!*

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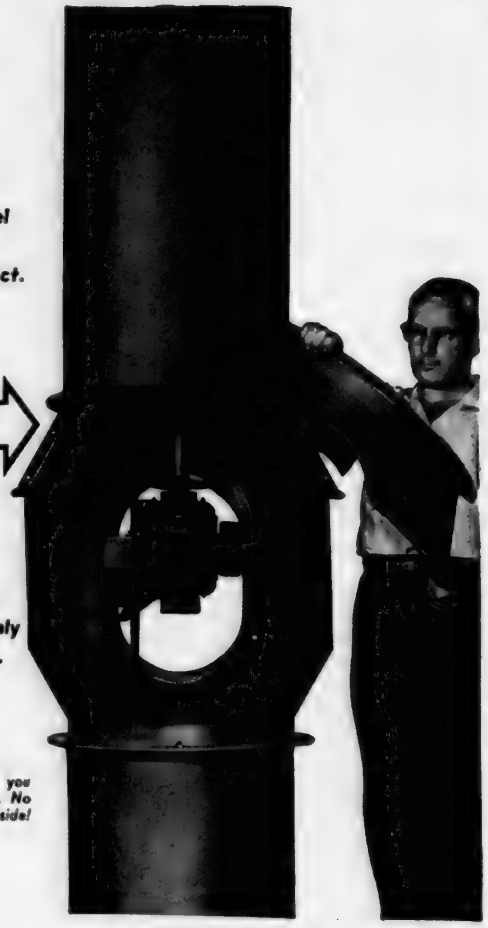

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Briefly Stated

(Continued from page 176)

copper tubing company. Earlier, he had been in the sales organization of Wolverine Tube for 12 years. . .

Don L. Warner has been appointed assistant sales manager of MARSH INSTRUMENT COMPANY, Division of Colorado Oil and Gas Corporation, Skokie, Ill., suburb of Chicago. He has been with Marsh for the past ten years handling instruments, valves, and related products. . .

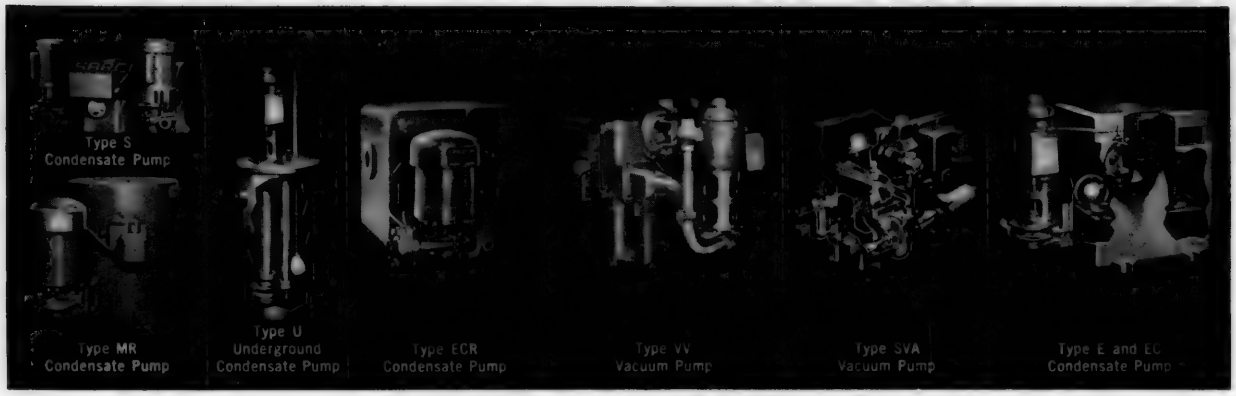
Appointment of David S. Soliday, Jr. as marketing manager, Warehouse Division, was announced by CHASE BRASS & COPPER CO., INC., Waterbury, Conn., a subsidiary of the Kennecott Copper Corporation. . .

Richard W. Lehman was promoted to manager of the Buffalo, N. Y., sales office of THE TRANE COMPANY. He succeeds Harper E. Whitaker, Jr. who resigned his office managerial duties to concentrate on a large account he developed for Trane. . .

Walter A. Curtis has been appointed general manager of PEERLESS ELECTRIC DIVISION, H. K. PORTER COMPANY, INC., Warren, Ohio. He will replace Shannon C. Powers who has been named general manager of National Electric Division of Porter in Ambridge, Pa. Mr. Curtis has been with Peerless Electric since 1947. Before assuming his new position, he was manager of fans and blowers. He is a member of the Air Moving and Conditioning Association and, in 1959, was its president. . .

Arnold R. McLain has been appointed general manager of YUBA HEAT TRANSFER DIVISION, YUBA CONSOLIDATED INDUSTRIES, INC., Honesdale, Pa. No announcement was made regarding the reassignment of E. A. Bertram, Yuba general manager for the past two years at the Honesdale plant. Mr. McLain comes to Yuba from Combustion Engineering, Inc., where

(Concluded on page 180)



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SARCO CONDENSATE PUMPS discharge to boilers fast . . . give quiet, dependable operation . . . are constructed of finest materials . . . engineered for quick, easy installation to meet a variety of conditions . . . have steel or cast iron receivers and close coupled or flexible coupled motors.

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Magni-Chek is a non-electric magnetically operated check valve, so finely calibrated that a fraction of an ounce of pressure will open the passage permitting a smooth flow without the usual pressure drop. Since no springs are used back pressure is at a minimum.

CHECK THESE FEATURES

- Built-in Monel Strainer
- Lifetime Alnico Magnet
- Maximum Flow
- Minimum Back Pressure
- Not Affected By Soldering Heat

This valve is also available without the strainer, and both types are stocked in the following sizes: ¼", ⅜", ⅜", ½", ⅝" and ¾". Special size inlet and outlet connections can be made to your specifications.

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For more data circle item 179A

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For more data circle item 179B

which size stack do YOU prefer?

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If you would like to reduce stack height . . . and gain optimum boiler efficiency . . . contact your local Lehigh Representative today. He'll gladly give you all the details. Or write directly to us for our detailed technical bulletin:

2171
LF-1

LEHIGH FAN & BLOWER DIVISION
FULLER COMPANY, CATASAUQUA 5, PA.
Subsidiary of General American Transportation Corporation

LEHIGH

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Briefly Stated

(Concluded from page 178)

he held the position of general manager of one of its large manufacturing divisions. . .

Hubert A. Essley, formerly vice-president, manufacturing and marketing, of TACO HEATERS, INCORPORATED, Cranston, R. I., has been promoted to vice-president in charge of operations. In this newly created position Mr. Essley will have complete responsibility for the operation of the manufacturing, marketing and engineering departments of the company. Mr. Essley has been associated with the company since 1928. . .

Philip B. Lockwood has been appointed as West Coast branch manager for CHRYSLER CORPORATION'S AIRTEMP DIVISION. He has been with Chrysler's air conditioning and heating division since 1955.

OBITUARIES

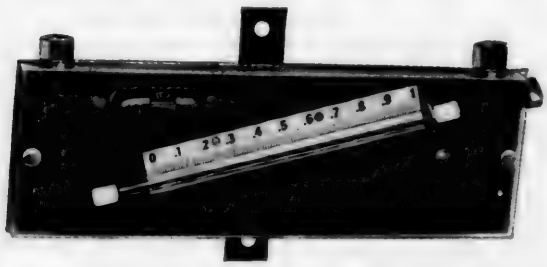
Among those who died in the collision of two airplanes over New York City on December 16 was Thomas J. Ryan, executive vice-president of Mechanical Contractors Association of America, Inc. An expert on labor law and legislation, Mr. Ryan came to MCAA as its executive secretary in August 1959 from his position as assistant general counsel of the National Labor Relations Board. He was elevated to the executive vice-presidency in May, 1960.

Stuart B. Leigh, executive vice-president and director of Thatcher Furnace Co., Garwood, N. J., was among the passengers on the ill-fated United Air Lines jet. Mr. Leigh had been with Thatcher since 1947. He was appointed executive vice-president and a member of the Thatcher Board of Directors last September. . .

Frederick D. Cooper, product planning specialist for the American-Standard (Detroit) Controls Division, died suddenly at his home in Detroit, Mich., following a brief illness. During his 24 years with the division, he became well known throughout the heating and ventilating industry.

YOU GET *accuracy with economy*

in this new Ellison "AFS" Air Filter Gage



The new Ellison Series AFS Air Filter Gages show when air filters have become clogged and need changing. Easy to install. Easy to read. Clear plastic snap-on cover keeps scale clean. A really accurate, well-made instrument at a surprisingly low cost. Eliminate guesswork and cut costs—no need to change filters until gage so indicates. The "AFS" is a new addition to the most complete line of air filter gages—the Ellison Line. A gage to fit every budget! Send for Bulletin 214-C.

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Draft Gages, Bell and Diafram—Inclined Draft Gages—Portable Inclined Tube Gages—Vertical Tube Gages, Oil, Heavy Liquid, Mercury, Single and Multi-tube—U-gages, Stationary and Portable—Air Filter Gages, Complete Line—Pitot Tubes—U-Path Steam Calorimeters—Portable Gas Analyzers, Orset Types—Alarm Systems—Orifice Flanges and Plates—Flow Tube Meters—Condensate Traps.

For more data circle item 181A

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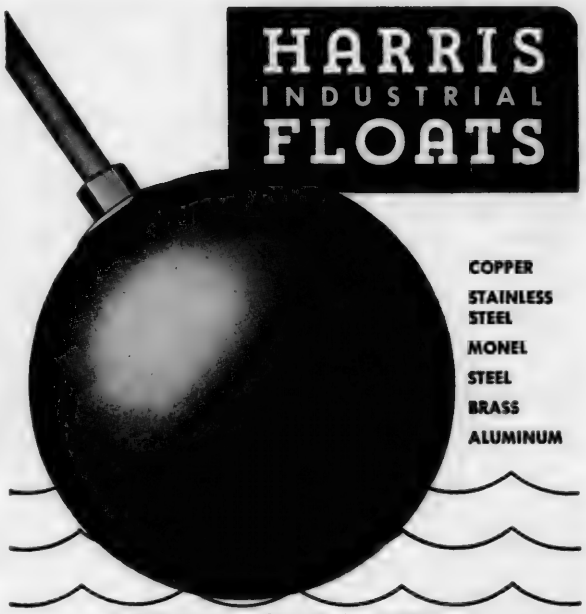

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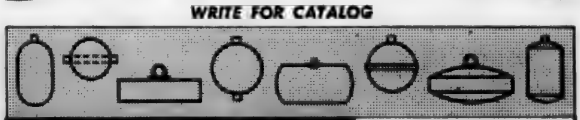

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For more data circle item 181C

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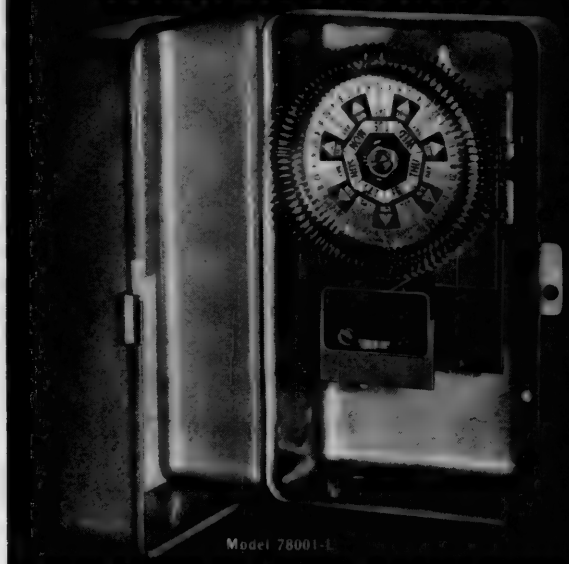
7-Day Time Switch with 20 Hour RESERVE POWER!



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Check These *Exclusive* TORK Features:

- Should power fail precision spring mechanism takes over instantly . . . keeps on time for 20 hours!
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- Choice of easy-to-set tab-type tripper dial . . . OR conventional ON-OFF dial!
- Available with Single Pole Single Throw, Double Pole Single Throw, Single Pole Double Throw, and Double Pole Double Throw switching.
- Highest capacity of any 7-Day Time Switch . . . up to 55 Amperes per pole.
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- Available without case, with bracket . . . or with Flush Enclosure, for panel mounting!

Here is the safest, most dependable Time Switch made . . . designed to meet the highest quality standards of Consulting Engineers and Architects. Insures comfort — no danger of Time Switch failing to operate when needed due to power failure. Economical too! No need for service screws to reset Time Switch after power failure.

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Most Complete Line of Time Switches for Heating, Ventilating, Air Conditioning, Refrigeration, Water Softening, Sewage Disposal, Pumping, and General Electrical Applications.

For more data circle this page number on card at back of book

BOOK REVIEWS

Publications abstracted in this department should be ordered direct from publisher.

ENCYCLOPEDIA OF SCIENCE AND TECHNOLOGY

A monumental work of 15 volumes has been published to cover today's scientific engineering and technical knowledge. It provides an authoritative reference on almost every conceivable topic in these fields. Because of the many new areas of interest into which engineering and science are expanding these volumes will be found most helpful.

The volumes were prepared under the guidance of an eminent advisory board, assisted by a group of 60 consulting editors. In all, there are over 100,000 entries prepared by 2,015 contributors, all specialists in their respective fields.

An annual supplement volume of about 500 pages will be published each Spring to maintain the practical usefulness of this encyclopedia and to keep the information current.

McGraw-Hill Encyclopedia of Science and Technology. Cloth bound — the 8,500 pages of text and 600 index pages are arranged in 15 volumes. Published by McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y. Price per set, $175.

AIR PURIFICATION IN BUILDINGS—As part of the 1960 Spring Conference of BRI, there was a program dealing with Cleaning and Purification of Air in Buildings. Six papers were presented ranging in subject from the meaning of pure air to future methods of air purification. BRI paper No. 797 has all the papers presented at this meeting and the discussions of the papers. Included as an appendix is a paper on Current Problems in Hospital Air Conditioning, by the late Dr. C. P. Yaglou of the Harvard School of Public Health. Building Research Institute, 2011 Constitution Ave. N. W., Washington 25, D. C. Price, $4.

ARI Standards — Two new standards have been issued by ARI. They are ARI Standard 516-60 on Refrigerant 12 and Refrigerant 22 Compressors and Condensing Units, 25 Horsepower and Larger, and ARI Standard 511 on Ammonia Compressors and Compressor Units. Standard 516 was designed to replace Standard 5-21 and 5-22; Standard 511 will replace Standards 5-12 and 5-13. Each of the new standards is priced at 50 cents and may be obtained from the Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave. N.W., Washington 6, D. C.

METAL CURTAIN WALL MANUAL—A new edition of this manual is now available and it is almost a complete revision of the previous edition. To holders of the previous edition, all that is necessary is to retain the section dividers and the loose leaf binder, and insert the new pages. As new methods, systems and products are developed, there will be new additions and revisions. National Association of Architectural Metal Manufacturers, 228 N. LaSalle St., Chicago 1, Ill. Price, $5.

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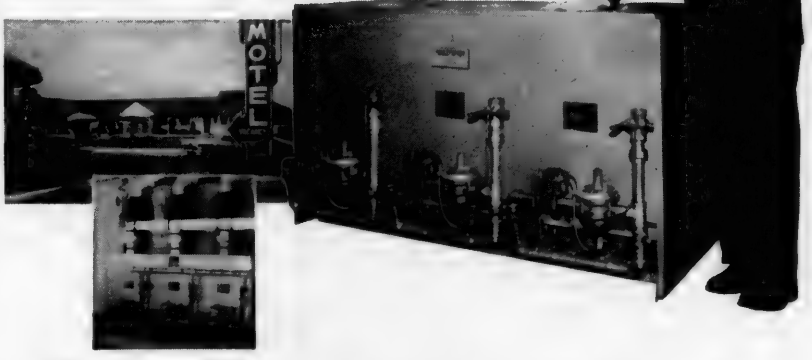

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What Readers Say:

(Continued from page 10)

mostat results in *serious* overheating of the room with attendant discomfort, temptation to open windows, attempts at adjusting the thermostat and inherent inconvenience to building operating personnel. All these plus the increased operating cost due to overheating. This increased cost can often offset the amount saved by depressing the building's temperature at night.

Unit ventilator unit-mounted thermostats are not located in the return air stream as Mr. Nordeen's article would lead one to believe. They are always located inside the unit ventilator in well engineered sampling chambers. The thermostat bulb is insulated from the various questionable side effects (to which the article refers) and is allowed to sense only room air temperature. Standard location of the engineered sampling chamber (which incidentally is provided as a standard option by all unit ventilator manufacturers) allows the unit ventilator fan to draw a sample of air directly from the classroom area occupied by the students, and thereby senses the temperature which the students really feel better than any thermostat located "on the wall." Also, results are always consistent—do not depend upon finding a good location for an "on the wall" thermostat.

Richard M. Plettner

Automatic Controls Division
Barber-Colman Company
Rockford, Ill.

Canadian Degree-Days for December, 1960*

City	December		Cumulative	
	1960	Normal	1960	Normal
Calgary, Alta.	1283	1430	3484	3660
Charlottetown, P. E. I.	1237	1210	2892	2850
Crescent Valley, B. C.	1215	1220	3289	3220
Edmonton, Alta.	1413	1660	3746	4070
Fort William, Ont.	1742	1680	3833	3960
Grande Prairie, Alta.	1457	1750	3954	4300
Halifax, N. S.	1075	1109	2396	2513
London, Ont.	1367	1200	2753	2680
Medicine Hat, Alta.	1369	1440	3294	3410
Moncton, N. B.	1310	1340	3068	3100
Montreal, P. Q.	1388	1390	2849	3040
North Bay, Ont.	1603	1550	3464	3620
Ottawa, Ont.	1435	1460	2966	3210
Penticton, B. C.	1085	1050	2664	2590
Prince George, B. C.	1362	1440	3687	3760
Quebec City, P. Q.	1526	1530	3372	3460
Regina, Sask.	1607	1740	3612	4150
St. John, N. B.	1278	1300	2989	3130
Saskatoon, Sask.	1622	1790	3999	4250
Timmins, Ont.	1847	1740	4105	4200
Toronto, Ont.	1234	1126	2394	2522
Vancouver, B. C.	798	810	2108	2120
Victoria, B. C.	726	730	2052	1970
Windsor, Ont.	1279	1130	2435	2440
Winnipeg, Man.	1844	1778	3959	4030

* These data are supplied through the courtesy of the Meteorological Division, Air Service Branch, Department of Transport, Canada.

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COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available.

ASHRAE MEETING—Semi-annual meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., at the Conrad Hilton Hotel, Chicago, Ill. Secretary, Robert C. Cross, 234 Fifth Ave., New York 1, N. Y. ..... **FEBRUARY 13-16, 1961.**

HEATING AND AIR CONDITIONING EXPOSITION — International Heating and Air Conditioning Exposition, at the International Amphitheater, Chicago, Ill. E. K. Stevens, International Exposition Co., 480 Lexington Ave., New York 17, N. Y. ..... **FEBRUARY 13-16, 1961.**

CHEMICAL ENGINEERS MEETING—National meeting of the American Institute of Chemical Engineers and the First Petrochemical and Refining Exposition, New Orleans, La. Meetings at Roosevelt Hotel and exposition at the Municipal Auditorium. American Institute of Chemical Engineers, 25 W. 45th St., New York 36, New York. ..... **FEBRUARY 26-MARCH 1, 1961.**

NATIONAL SYMPOSIUM ON TEMPERATURE—Third National Symposium on Temperature—Its Measurement and Control in Science and Industry, sponsored jointly by the American Institute of Physics, Instrument Society of America, and the National Bureau of Standards, to be held in Columbus, Ohio. C. L. Roberson, ISA, 313 Sixth Ave., Pittsburgh 22, Pa. ..... **MARCH 27-31, 1961.**

CORROSION ENGINEERS CONFERENCE—Annual Conference and Corrosion Show of the National Association of Corrosion-Engineers, at the Statler Hotel, Buffalo, N. Y. T. Hull, executive secretary of the Association, 1061 M&M Building, Houston 2, Tex. ..... **APRIL 5-7, 1961.**

INDUSTRIAL HYGIENE CONFERENCE — Annual American Industrial Hygiene Conference at the Sheraton-Cadillac Hotel, Detroit, Mich. Publicity chairman, J. D. MacEwen, Wayne State University, 1401 Rivard St., Detroit 7, Mich. ..... **APRIL 9-13, 1961.**

CONVENTION ON WELDING—Annual convention of the American Welding Society, The Coliseum, New York, N. Y. For information write, American Welding Society, 33 W. 39th St., New York 18, N. Y. ..... **APRIL 18-20, 1961.**

NATIONAL CONVENTION—The 39th Annual Convention of the Oil Heat Institute of America will be held at the Statler-Hilton Hotel, Washington, D. C. ..... **APRIL 23-27, 1961.**

CONSULTING ENGINEERS COUNCIL—Annual meeting of the Board of Directors of Consulting Engineers Council, at Executive House, Chicago, Ill. Executive Secretary, L. N. Spiller, 326 Reisch Bldg., Springfield, Ill. ..... **MAY 4-6, 1961.**

BRI SPRING CONFERENCE—Building Research Institute Spring Conference, Shoreham Hotel, Washington, D. C. BRI, 2101 Constitution Ave., Washington 25, D. C. ..... **MAY 16-18, 1961.**

DESIGN ENGINEERING CONFERENCE AND SHOW—Design Engineering Show, Cobo Hall, Detroit, Michigan. Exposition management by Clapp and Poliak Inc., 341 Madison Ave., New York 17, N. Y. ..... **MAY 22-25, 1961.**

NDHA MEETING—Annual meeting of the National District Heating Association, Wentworth-by-the-Sea, Portsmouth, N. H. Secretary, John F. Collins, Jr., 827 N. Euclid Ave., Pittsburgh 6, Pa. ..... **JUNE 12-15, 1961.**

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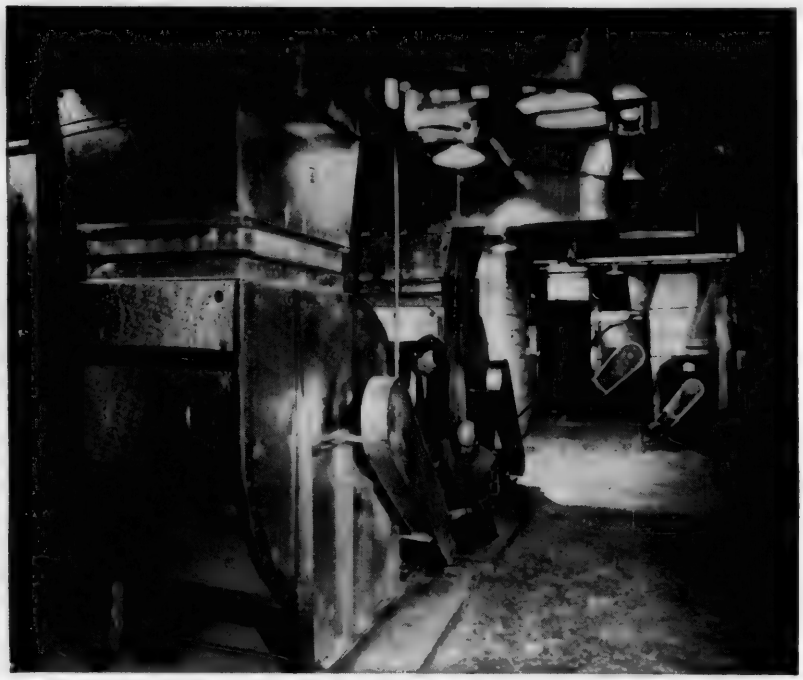

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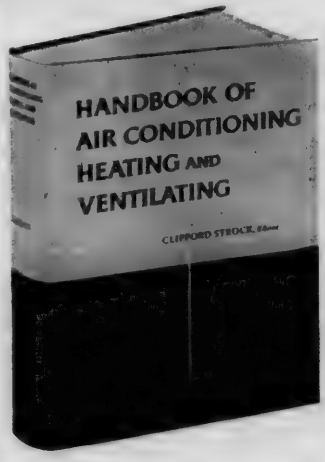

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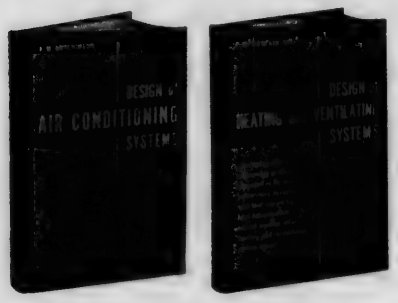

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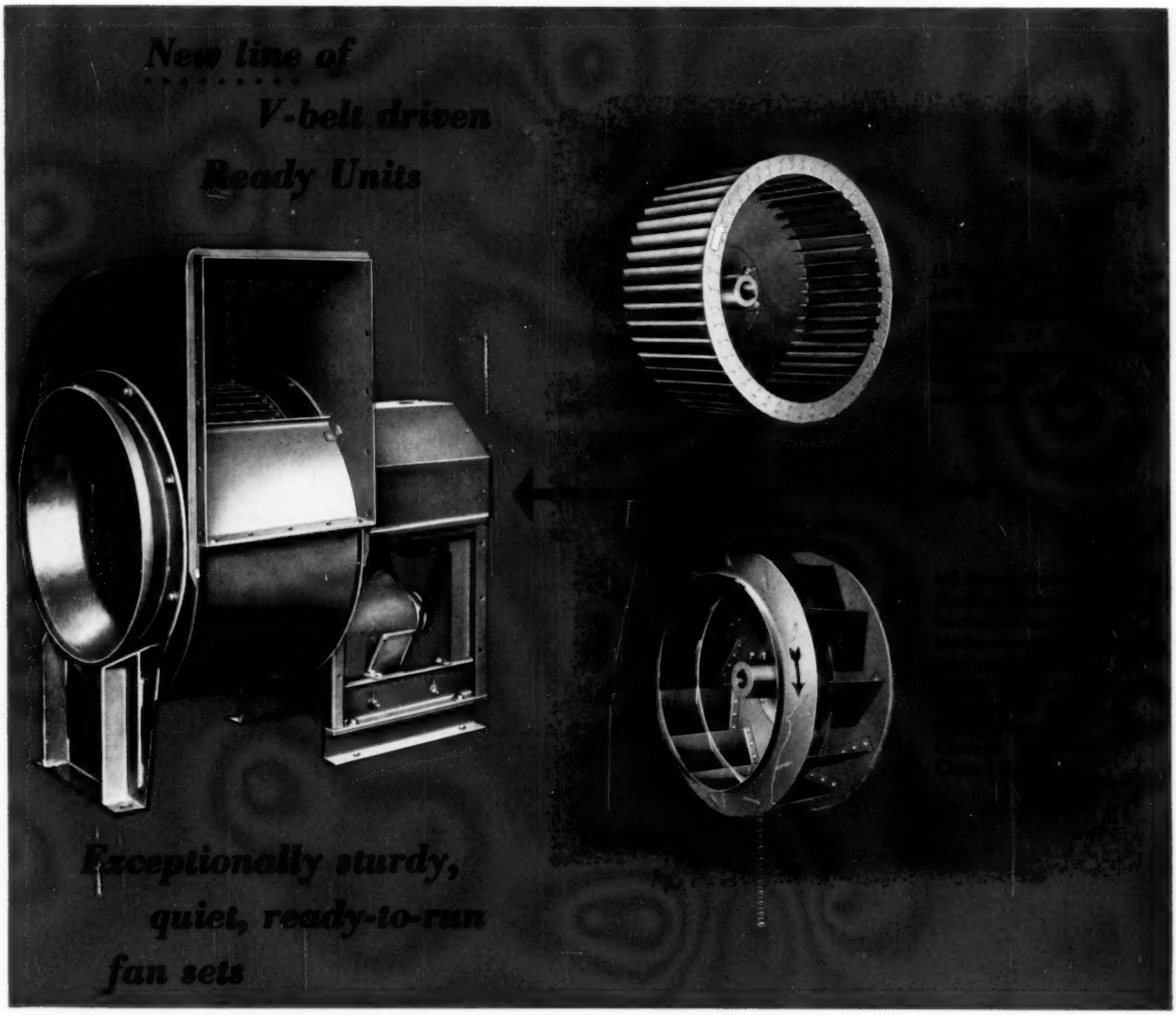

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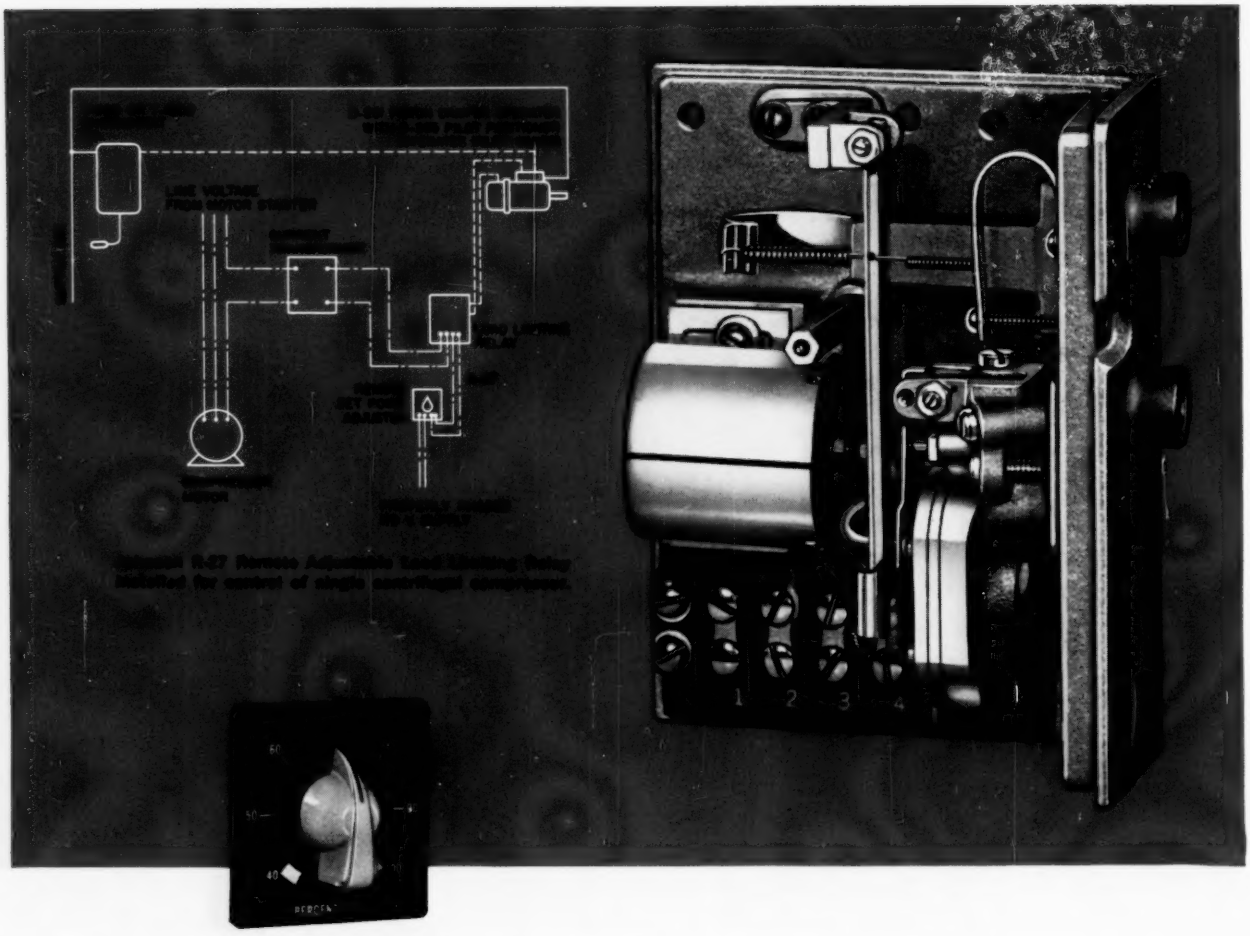

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